

IRON THE LEVER OF ENGLAND'S COMMERCE.

ALUMINIUM THE BRIGHT STAR OF METALS

CHEMISTIANITY



THE AUTHOR'S OWN EDITION.

OXYGEN THE QUEEN OF BODY AFFECTION

COPPER THE SIAMATIC BOND METAL.



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# Chemistianity,

(POPULAR KNOWLEDGE OF CHEMISTRY,)

A POEM;

ALSO AN

RATORICAL ERSE

ON

EACH KNOWN CHEMICAL ELEMENT

IN THE UNIVERSE,

GIVING DESCRIPTION, PROPERTIES, SOURCES, PREPARATION,

AND CHIEF USES.

*ARRANGED for FAMILIAR or MEMORY READING,*

BY

J. CARRINGTON SELLARS, F.C.S.

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# Chemistianity.

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*Copy of Oratorical Verses, No. 572.*

CHARACTERISTICS.—This Work, written in the hope that it may be found suitable for the practise of reading aloud (in an elocutionary manner) to acquire a brief knowledge of Chemistry, for impressive reading; is printed with new type, on paper made specially and watermarked “Chemistianity.” Each copy is numbered in consecutive order of issue. The work is published in two forms:—

1ST—CHEMISTIANITY, with THE ORATORICAL VERSES ON THE ELEMENTS—Bound in cloth, extra bevelled boards—foolscap 8vo.

2ND—THE ORATORICAL VERSES ON THE ELEMENTS, Bound in brown limp cloth—foolscap 8vo.

WILLMER AND SONS, STEAM PRINTERS, CHESTER STREET, BIRKENHEAD.



# CHEMISTIANITY.



## PROCEMIUM.

Dear Friends,

I step forward, to hand you my brief work,  
With native diffidence and humility;

**Late Formality** is a smiling sick man  
Mete-ing out Vanity to blind true feeling,  
I have not the measure, therefore extend  
My two hands to you as warm friend to friend.

\* Chemistianity or Chymistianity.

My aim in Work was verse narrational  
On each known Element term'd Chemical;  
Such bodies compose in God-govern'd Rule  
The Earth, the Sun, and each Matter Nodule  
That, life-like, wisely move in **Sea of Space**  
For man's learning in God's eternal grace:  
As these bodies compound our Spirit's Frame  
We should know them well by **sight, rule, and name.**  
In that we can exert force Chemical  
So we only, of all life Animal,  
In that are like to the **Primal Causer,**  
The **infinite Motioner of Matter.**  
Wide would I spread, were it my privilege,  
**Religion, Chemistry, and Trade Knowledge,**  
Coupling with those first studies—**Elocution,**  
Four essentials for a Life of Progression.  
Permit me now to give the author's sum  
Of this my **first** book p'rhaps ultimatum.



I trust you Jury, though all will not agree,  
You'll pass a verdict that will favour me.

The title I chose is CHEMISTIANITY  
Or, Proofs of Chemist's love FOR all Humanity;  
God-love in Christ—CHRISTIANITY,  
Is to—in and through—Humanity,  
Two unequal friends walking, gifting, o'er the Earth,  
One **Basic Merit**, the other, **Incomparable Worth**.

**Chemistry** 's the Science of all science,  
To disciples first-hand **God evidence**.

This hand-book is arranged in four parts (*vide* Index)  
**Proœmium**, **Prologue**, **Verses**, and **Appendix**;  
Four sections, forming an empiric whole,  
To cater to the Mind and earth-dimm'd Soul,  
To yeast human thought for the bright **Stream-Sea**

When the soul leaves the clod for Just Eternity.

**THE PROÆMIUM** is the \***Play Shed to my Work,**

Where, to relieve my brain from thoughts that irk,

For two sep'rate half hours in each work day,

After shutting off Steam, I go to play ;

On wheeled skates make circuit of my ground,

And tongue my verse to test for metre'd sound ;

Play dux, by import of my deductions,

With the meaning in Chemist's prose productions :

Box, wrestle, or fence with false evidence

And vault o'er diff'rence of small consequence ;

Withal, aiming to climb the greased-pole of Fame,

Beginning with the ill of a born trade name.

[ 'Tis not a name that makes a man worthy

But his **worthful deeds** to needing community.]

\* Our Park lacks a Play Shed at each corner,

With Quoits, Bare-poles, Dumb-bells, and Monitor.

There also I stack my waste from the Prologue  
And review my work much like in Epilogue.

**THE PROLOGUE** I trust is exhortative,  
*Dei in Excelsis*, with tendency  
To exalt, to a high peak of honour,  
Beneficent, true, Chemistry students  
Nature's Law Musers, of whose fair works  
We Chemistians are but the readers.  
The contrast between us is like that between  
An Elocutionist and a Poet,  
One simply reads what the other has composed.

Oft have I marvell'd at Druggists' **profanity**  
Their lore is based on Chemistianity.  
Drugs often prove corrosive permeants,  
Afflicting double for single heal,  
While removing the sore they sow ill broadcast;

The whole system being slightly attacked  
Nature may succeed in expelling the evil  
Time after time, until her corpuscles  
Becoming clogged by super-saturation  
Death is the natural supervention.  
The diff'rent sects of Medical Parties  
Are more militant, and truth-denying,  
Than are men of adverse political factions.  
May **Truth** and **int'rests** of **Humanity**  
Soon cause definements of Drug-charmery.  
Your potent, crest-low'ring, **Opposition**  
Is the Bar to the smooth Harbour of Progress :  
It needs time, ready steam, and skill to tide it.

**Perplexity** is like blinding drift snow,  
So in **Test Room**, **Labor'tory**, or **Factory**,  
There's nothing so mentally confusing,  
So work hind'ring, time and profit missing,

As an upset, thrown about, bench of gear ;  
Each article in frequent use should receive  
Daily attention, a moment's trimming.  
Idle plant for Store Room should be marked,  
Inventoried, and ranged in book'd order.  
The remedy for perplexing habits,  
Is apt reflection and little natty ways.

Free Chemical lectures would do great good ;  
We might have **Notice Boards** (Public Intimators)  
One for Religion, Science, and Elocution  
Other for Plays, Concerts, and Entertainments ;  
Such announcements of subject, time, and terms,  
(Single line in wood type) placed at four-road-ends,  
Stations, and Ferries, would cost but trifle,  
And guide Labour-Youth to tasteful pleasures.

Health and Equity require **Prize Chemistians**

Nominated by State rule through Districts,  
And who, triennially translocated,  
Sworn above corruption, and arm'd with severe law,  
May freely enter registered Workshops  
Where food, liquors, and condiments, are prepared ;  
And, (all inventions being protected  
By kin trade committee's Letters Patent)  
Have legal passports through all Factories.  
Such **degree'd Chemistians**, public analysts,  
Could, by special request, certificate  
Utility of district manufactures ;  
Be true safeguards to Life and Honesty,  
And, by affirm'd reports, check villainy ;  
They could print the circumstantial **greed-effect**  
Of brown paper leather for withstanding weather ;  
Use of Cotton polish'd, where Silk should have flourish'd ;  
Beer **made** in lieu of **brew'd** ; seed spirit **boiled** not **stew'd** ;  
Flours and sweetmeats poison'd ; homes and towns dis-ozoned.

Dear ladies of current period, need  
Speedy trains to speed their spouses homeward,  
Where, children's appeals dumb'd by thick wall'd domiciles,  
Midday pleasures are enjoyed in dinners at home.  
The tram may be Ice, or metal, on Ice.

\* **Matter in expressiveness denounceth,**  
Among recreants most noteable,  
Certain Orphan-robbing Executors,  
Dissemblers who, with smooth Gothic face,  
Substitute their vice for Testator's Will,  
In open day condemn innocent youth  
To lower social grade than was first devised.  
Nulling Parent's love to their own behoof.  
Society lacks **Will Administer Courts**  
Composed of honour'd avow'd responsables,  
Paid on percentage of trusted Capital,

\* Vide Matter's expressiveness to Man, page LXI.



With requitement for special Commissions.

**Necessity** cries, to her rich child Son fie,  
Fie son ! I've rear'd thee, fed thee with sweetmeats,  
Gin thee twice thrice thy heart's first desire,  
And yet thou would'st turn and tend better men  
But one-tenth the proving-cost of **Virtue** ;  
Thou mizerdote, love God and do right to all.  
All late merchants **house** their estate-builders.

**Usuring traders**, rich with slave-earned wealth,  
Who offer **Aid**, per law-evading Bills,  
For int'rest one hundred and fifty per cent !  
**State Institutions** for poor Inventors,  
Who with bounden truth and humility  
Will legally subscribe, would be a boon.

Let us encourage brief, public knowledge



Of high learning ; in the long last it will fruit,  
Pleasure may, but necessity 's sure to sprout it.

Of all the Holy days through the round year  
One may, for events, be mournful or gay  
Except on one, sacred, restful Sunday ;  
Beaming love is due on that hallow'd day,  
Cessation from work, no profane pleasure,  
But halleluiah God louder than Nature ;  
Worship at least once with **Christ-native** man,  
Who nurses **nascent souls** for life without span.  
**Sabbath-working** is sign infallible  
Of the Soul's bankruptcy, the precursor  
To National Imbecility.

## THE ELEMENTAL CHAPTERS or VERSES

(I prefer name **ORATORICAL VERSES**)

Are familiar accounts of each Element

At present known in our vast Universe ;  
With brief s n e c c i n e t lines on **Simple Bodies**,  
Chief **Natural Laws**, and **Art processes**.  
Each Oratoric verse is thus arranged :—

**Description.**

**Properties** (and of compounds where important.)

**Source.**

**Preparation.**

**Chief Uses.**

Oh ! would that the writers of Systems,  
Themselves, would write in some approved system,  
Express their facts and views in vied language  
With truth, similes, and impressiveness :  
Then would there be less obscurity  
And more learning, yielding hornpipe joys through Earth.  
I conceived the thought of writing in verse,  
My essay at pithy Lancashire sense,  
In humility and without precedent

For promoting Chemistry and Elocution.

A Poet, e'en if aged, must appear young,  
And to be successful, however young,  
Must speak aged. He's like a solar system  
Within himself, his mind whilst juvenile  
Is as our system was—so spacious  
As to be almost ideal—but, through time,  
It consolidates and fructifies ;  
His matured thought becomes planetary :  
These Primary Planets, with their Satellites,  
Serve as reflecting butts for his capricious wit,  
His inner mind being the Prime Mover :  
Sometimes his dreams, like Comets, shine brilliantly  
And sweep their thin trains o'er perfecting Thoughts  
'Till solid sense, emerging, proves their Rarity.  
Finally his whole system's hurried on  
To an attracting final merging Sun.

A would-be in kind practical Poet,  
Is one who takes a hard sounding Science  
And, piping with the words of common sense,  
Makes music in genial eloquence.  
Similes, like Mister Punch's phizzes,  
Are stellar number'd—so are Judy's quizzes.  
Rhyming music, for sense, is often found  
Too curt, or word-blown, for the sake of sound.  
One toned word, like an old familiar tune,  
Will suffice to cant-er a rhyming coon.

I have not yoked my song with Chemists' names,  
Full i' th'ear manuals fully record them.  
I **bring up** and open out certain words  
To typify the worth of some valued points,  
In other cases, perhaps of equal force,  
I do not to avoid detraction.  
I use in full meaning each common word,

*Vide* complete dictionary for thoughts inferr'd.

For permission to glean information

From published works, I tender my sincere thanks

To the here named Chemists, Authors, and Gentlemen:—

**Chemist Edward Frankland, D.C.L., F.R.S.,**

Professor of Chemistry, The Royal College of Chemistry, London.  
(Formerly Professor of Chemistry, Owens College, Manchester.)  
Author of \* "Frankland's Lecture Notes," &c.

**Chemist Henry E. Roscoe, Ph.D., F.R.S.,**

Professor of Chemistry, Owens College, Manchester. Author of  
\* "Lessons in Elementary Chemistry," &c.

**Chemist Henry Watts, B.A., F.R.S.,**

Editor of \* "Watts' Dictionary of Chemistry," Editor of "The Journal  
of the Chemical Society." Reviser of \* "Fownes' Manual of Chemis-  
try," &c.

**Wm. Geo. Valentin, Esq., F.C.S.,**

Chief Demonstrator of Practical Chemistry in the Royal School of  
Mines. Author of \* "Valentin's Text Book of Practical Chemistry," &c.

**A. Vacher, Esq., F.C.S.,**

The School of Chemistry, Gt. Marlborough-Street, London. Translator  
of \* Dr. Fresenius' Works—"Qualitative and Quantitative Analysis," &c.

**Astronomer J. Norman Lockyer, F.R.S.,**

Editor of "The Heavens" Astronomical Newspaper. Author of  
\* "Elementary Lessons in Astronomy," &c.

**Messrs. Macmillan & Co., of London, Edinburgh, and  
New York,**

Publishers to the University of Oxford, \* Macmillan's School Class  
Books, &c., &c.

\* Vide Advertisements at end of book.

My provisional Chemical knowledge

I received from my lore'd tutor Chemist Frankland,

Then Professor of Chemistry, Owens College.

Preceding him were my boyhood instructors

Daniel Stone, Esq., F.C.S.

(Then of Oxford Street, Manchester),

And Geo. Hamilton, Esq., F.R.A.S.,

Lecturer on Chemistry (then of New Brighton College, now of Queen's College, Liverpool.)

**Foundation-layers** of well-built education

Have their names graved in the heart of the pile,

For them, native and art tact wreath immortelles.

Who feels not grateful to priming tutors

Proves vile witted, thankless, thriftless, godless.

With book gleanings I had technical knowledge.

One oft derives shaded gleams of pleasure

In remembering School and College days

When elected commodore of mimic fleet,

“Bear” wrestler, or oarsman in boating feat,

When we made ice, crystals, colours, assays,  
 Fireworks, explosives, and 'lectric displays.  
 It proved a mine of easy-got pure pleasure  
 In answer to my quests to receive such grants

As these :—

Royal College of Chemistry, South Kensington Museum, S.W.

My dear Sir,—If you supplement the list you mention, by Watts' Dictionary of Chemistry with Supplementary volume, you will I think have before you a very complete synopsis of the present condition of Chemical Science; \* \* \* \* \*

Yours truly, E. FRANKLAND.

---

151, King Henry's Road, London, N.W.

Dear Sir,—I beg to say that I can have no objection whatever to any reference being made to my published works. Indeed it appears to me that when a book is published, anybody is at liberty to refer to it or quote from it just as he likes. With regard to Scientific works in particular the facts detailed in them are the common property of Science, and are laid out for the use and behoof of all who take interest in them. \* \* \* With best wishes for the success of your book

I am truly yours, HENRY WATTS.

---

Royal College of Chemistry, South Kensington.

Dear Sir,—If in my book any lines you can discern, to ease your work or serve a happy turn, take them and mould them to your will. \* \* \*

I remain yours truly, WM. VALENTIN.

---

I jot these notes to show you the feeling  
 Amongst Science' sons in our present day,  
 That we may duly praise and honour them;  
 Thank God for spring rays of a summer state.  
 Thanks with Honour are Gratitude's Pages,



I pray you friends page my contributors,  
 In genital duty, by reading their works;  
 Their deeds shine bright with absorbable rays  
 In God's great command—Light for coming days.  
**Knowledge**, is acquaintance with effect of Laws.  
**High Wit**, intimacy with their mode of action.  
**Godly lore**, their partial beneficent adoption.  
**True Wisdom** is the \* **Lord Goceptor's power**.  
**Ignorance** is the orderless use of laws,  
 God-love and Science are its monitors.  
**Sub-earth-will** is dominant vicious spite,  
 Perverse opposition to honest right.  
**Simplicity** is often high delight  
 As, when simple thoughted on a starry night.  
 You view the majesty of celestial light.

Therefore a human being may be said to be, on certain  
 subjects—simple, knowledgeable, subearthwill'd, high-

\* Vide Goception—page 5. (Natural Laws and Art Processes.)



witted, or with godly lore endowed. One division of the condition of a **moleculed** Being might (diffidently) be imagined as that of **clarified** godly lore.

The Great **Precipitant** and **Displacer** of Earthy dross and subearthwill is a commingling with the spirit of **Pure-nature-with-God** JESUS CHRIST; though, whilst the soul is in the **nascent** enveloped state, never full clarifier, as known by the admitted sins of every God-born soul, therefore trust none altogether curbless.

A lawless Atom, or a loveless soul, does not exist in nature, so 'tis impossible for any hampered being (earth-clouded soul) to rationally assert that a soul perishes—*i.e.*, dies or disintegrates—as doth the body.

The **sixty-three** Alphabetic verses

Are composed of sapful, essential matter,

For present days—a required chemical minimum.

Every detail is not here embraced

But the chief suggestive **practical facts**;

For full Chemistry, the books I most commend

Are first :—

A fair version of **Chemistianity**, made familiar  
By frequent readings; then  
Chemist Roscoe's "Lessons in Elementary Chemistry,"  
Chemist Frankland's "Lecture Notes for chemical students,"  
Chemist Watts' edition of "Fownes' Manual of Chemistry," or  
Wm. Geo. Valentin's "Text book of Practical Chemistry,"  
A. Vacher's Version of "Fresenius' Qualitative and Quantitative Analysis." And, finally,  
Chemist Watts' **Dictionary of Chemistry**.

This work may prove a memory burnisher,  
To teen-youth or octogenarian,  
And act as match or chemistian torch  
For needed light to order Ignorance.  
The sounds in speech impart heat to auditors  
May annexed lines, read, kindle science in your mind,  
Spark your latent love to **The High Goceptor**,  
And impart **sound-heat-motion** to your fellows,

Prompting like pitch'd minds by Tuned vibraters.  
Were it not for my chemistian knowledge  
I should have been floundering on my back,  
Crab-like, vainly clutching the but tempting air  
Until I'd sunk in ignominious mud :  
But, thanks to flowing sea of God's providing love,  
I can keep my stand, my walk, and do fair battle.

## CHEMISTIAN SONG.

Chemistian lore should be  
Well known on land and sea  
To sow the seed of **Chemistry**, so heigh, so ho, so hee,  
  
Its creed will good seed sow,  
**Honour** and **Virtue** grow,  
Like Banian spreading **Liberty**, so heigh, so hee, so ho.  
  
For work, and happy play,

No lore's so good we say

As bright **Chemistianity**, so hee, so ho, so heigh.

To train all youth's the plea,

By tutors paid and free,

In **Science** link'd with **Piety**, so heigh, so ho, so hee.

Then belle will walk with beau

In gainful gorgeous show,

Fine **Art** will glow with born **Beauty**, so heigh, so hee, so ho.

Blart quacks will lose their say,

**Labour** have its due day,

**Capital** work'd in **Equity**, so hee, so ho, so heigh.

All men will impuls'd be

To store for need, like bee,

With love to **Queen** and **Country**, so heigh, so ho, so hee.

Miss Basic Merit's foe

**Trade-fraud** we'll plunge in woe,

And urge **Commercial Honesty**, so heigh, so hee, so ho.

Then hip, hip, hip, hurray,

Chemistians love their day

Germ'd in the **Nineteenth Century**, so hee, so ho, so heigh.

**Elocution** is childlike utterance

Matured and dignified. Children's pure speech

Is colloquial excellence ; forte their sweet sounds.

Its familiar use is of vast service,

'Tis the ready tongue to clear sense. Its apt force

Strengthens you in ethical, political,

And scientific discussions ;

Aids you in selling, cues you when buying,

'Tis the fruitful germ to Oratory :

Its bent counterfeits are seen in city swells,

Bullying butchers, yah yah druggists,  
*Re* “this evening” “this occasion” lecturers,  
 And in swindlers of blunt, and polished, assurance.  
 By the genuineness of a man’s speech  
 Often his true motives are transpared.  
 Available types for good Elocution,  
 Besides (exceptions) skill’d Christian pastors,  
 Are thorough-striving home-hitting Actors  
 Who, oft beset with cold and home-blank cares,  
 Yet dew and rage their speech in all due majesty,  
 For such let your plaudits be long and pro—longed.  
 Practise Elocution in spacious room,  
 Articulate **Bell** modulated tones  
 Alone in your chamber to seemly limits,  
 There stand, on fancied platform, and declaim  
 Your set speech and imagined argument.  
 [Shun slight tenements, and, envious associates,  
 Consequent evils to present ignorance.

'Tis a noteworthy fact, all onward people  
Have some baneful, evil-sun neighbours,  
Persons of dull chameleon virtue,  
Varnished fames, and questionable intents ;  
The remedy is truth to principle,  
Following **excelsior** laws to unfear'd death].  
Speak not hurriedly, your fast speaker  
Seldom is a deep thinker. To groove deep  
In the hard-wood of Thought work leisurely,  
Think twice ere speaking and speak your choice thought ;  
He who birrles away like unwinding alarum  
Is often vainful, self-willed, and, by his rash words,  
Unfaithful, friend-cutter, mischief maker ;  
In argument threaps that Rheumatism,  
Or an ailment, is not a disease ;  
In trade adventures constitutes himself  
A safe captain of one voyage steamers.  
In every race there are odd characters



Whose powers for reflection are deficient,  
Oft lacking space to sublime emanant thoughts,  
Such an one no sooner conceives an idea  
Than his innate force, forces instant speech ;  
If a soldier, and braved, he's chance valiant,  
If scared, he's a coward the most arrant,  
By these faults he's open to be out-witted  
Unless govern'd by sober'd premium thought.  
Speak slowly, metrically, cadentially.

**THE APPENDIX** contains a proposed code  
Of Alphabetical Composition Names,  
For prompt distinction of \*floral bodies  
When tracing out a chemical equation ;  
'Tis submitted in diffidence with deference.  
Present names are admittedly anomalous

\* Vide page 46.



Tending to disperse thoughts, not their collection ;  
For **nourishing** virtue we endure the terms  
As when, *en route*, through \***Liver-pool East**,  
And wishing like lord sumptuously to feast,  
We grace Gosden's "London," Clayton Square East.

Learning should unravel old mysteries,  
And its language be free from obscurities.  
I love God and I love real Science,  
I hold true Science germs high love to God ;  
Many men of high wit have their crotchets,  
Often held through perversity of will,  
And live for years in seem'd delight of them.  
Woe, woe, to evil administrators,  
And **more** to those who, like Maister Godnot,  
In wanton, selfish, hateful ambition,  
Expound false theories for pocket honour ;

\* Old Town (Liverpool) Liverpool East. New Town (Birkenhead) Liverpool West.

Such men are maelstroms to ill-bred, straw-like, care-not  
[minds.

Having crossed-the-line of private character  
I must submit to critics rule of sea,  
Be dipp'd in initiating water,  
And list all opinions coarse, fine, or free.  
In any antecedent quest  
'Tis not what your ancestral fathers were  
But give me character of your mother,  
Aye, there's the quest, tell me of dear mother,  
That's the being whose virtues make the man.  
Ere passing judgment on my fallible head,  
Allow for nature's atomic oddness ;  
I may quoit at the hob of excellence,  
But with my aim I scarce expect to pink it :  
Success is best reached when in princely mood,  
By delib'rate thought and well measured span ;

In a period of vulgar health  
 I may o'erthrow the arm strength'ning missile ;  
 In an hour of hateful nervous feeling,  
 Hurl in erratic whirl the hard-cased ring ;  
 Whilst, at other times, driving with abject swing,  
 In toneless spurt I aim with wretched underfling.  
 By my crude maiden-book confession  
 Mehopes I've drawn the teeth and claw nails,  
 Of Lion critics. Their puss play then I don't mind.  
 Waste-paper set-trap writers shall daunt me not,  
 The greased feather of my good intents  
 Shall repel their assafoetidal script  
 As freezing water from Muscovy duck ;  
 Though a discretional power I retain  
 To re-**compass** my course, as any youth  
 With a predominant story tell Sister.

Criticisms, vexatious or unfair,

Once entered in print, no matter where,  
According to rule of modern writ war,  
(Like the honour challenge in times of yore),  
A clear copy should by writer be sent  
Post free to await attackee's comment;  
I myself may not take any notice  
But rely on public sense for justice.  
According sound pulsations quickly tell  
In toning an Educational Bell;  
In these days of cheap postages and franks  
'Tis easy to respond and express thanks;  
One expects not a perfectly even course,  
Race-grounds are not always free from stones and gorse.  
Young as I and Chemistianity are  
We've already received a little bant a h r  
A friend who saw a part of printed book,  
And through the lines gave a general look,  
'Told me he knew nothing of Chemistry

Nor accent nor measure in Poetry,  
Yet quoted the most sing'lar idea  
“ Count not syllables with lines of Shakespeare.”  
'Tis evident 'tis little I ever knew  
Of Shakespeare's writings, gloryful and true,  
Of Plays I've ne'er read half the number ten,  
And those (less odd speeches) but now and then ;  
My unworth thought of that God-honoured man  
Is that he was a full-o'-faith Christian,  
With thought unfathomable—time doth tell—  
Like a molten-sea based Artesian well.  
I once met a read enemy to Shakespeare,  
A last-resort man, in manners austere,  
'Tis enough to know, he express'd to ladies  
His pers'nal abhorrence of dogs and babies.  
A superficial thinker, of some fame,  
Laugh'd outscornfully at intent and name.  
Friendly banter, and associate's satire,

To set-coursed minds are needle deflectors ;  
The **Love Sun**, with Home-ties, and World duties,  
Are their correctors.

Apt encouragement  
Vies the heart, recalls the skirmishing wit,  
And strings each nerve-al bend for soldier-like  
Evolutions.

Having concluded my verse  
I pass for copy to Amannensis,  
One who throughout, in \*late requited hours,  
Has kept a clear course through my cross-sea of notes.  
No Nation, Community, or Man,  
Has right, or cause, to compile trade treasure  
Without house-ing the unsweal'd health of people.

\*Commercial Clerks for extra time should be compensated. The Author has knowledge of a small struggling trade-house, where, for eight years previous to the trade strike, each clerk has been so paid. May some such rule soon become a principle. View'd anteriorly it would seem ill got wealth-material, for a land owner to go begging milk for butter amongst his paid-up cottago tenants. Cravers for equity might exercise their prerogatives at home.

Skilled labour and capital work'd in equity  
Would systematize society through the world.

I most sincerely thank my Chemist friends  
For marking errors, their correction tends  
To make my humble Work, if it should please,  
In learning Chemistry, a book of ease.

Dear friends,

Let us band Earth with Knowledge  
    round her \*comely round waist,  
'Gainst **Ignorant Assumption**  
    spread Chemistian lore taste,  
And with **Good-will**, in Missions,  
    from sea poles embrace her,  
That **Comfort** with **High Pleasure**  
    may gang through world together.

\* Comeliness is ever full nature-al, fruitful, and in high degree beautiful.

xxxviii CHEMISTIANITY.—PROÆMIUM.

An' it please you I may write further, it depends  
On God's super-current will for faculties,  
And your approving nod for circumstances.

J. C. S.

, *Ferry Buildings,*

*Birkenhead, October, 1873.*









## PROLOGUE.

The **Arts** of Nature  
Are **Developement** and **Reproduction**,  
Chemistianity their Commentary  
And kindly practice. A God-like creed.  
May ROYAL LABORATORIES be placed  
At gracious intervals through our Empire,  
Then **appointed men** preparing local Products  
Might interchange them at the State's expense ;  
So prepared Elements, with their compounds,  
Made Commercially or Chemically pure,  
(For certified inquestive purpose solely),  
Could be obtained at av'rage cost through country.

Let us create them, and SCIENCE MISSIONS,  
And INSTITUTE **instructors** on Licentiate law,  
Equipping each by men who, in their good studies,  
For our universal good, are vied on  
By the secur'ty of their own welfare,  
Martial, \*hainful pay, with *ad valorem*  
Premiums for virtuous tasks achieved.  
Let choice Communicants of such a stamp,  
Per Laboratories—public, and endowed,  
At School, College, and University,  
Disseminate the lore of Chemistry.

MATTER is Affection's **embodiment**;  
Its perpetual motions—Procreation  
Which, in varied efflorescence call'd Life.  
Culminates in Nature's choicest flower—Man.  
The familiar scansion of such motions

\* An old English word signifying more than sufficient for present use.

Is the Chemist's love, the Law Poet's work.

The essential labour of the Chemist

Agglomerates Material knowledge,

E'en as your summer cloud doth water.

**Chemical knowledge** the aspiring Alchymists sought,

And racked their brains to transmute metals:

Many are the wondrous tales that are told

How tin and copper, blended, oft made gold:

They failed in act though they assumed a fact,

That Metals are kin in Earth's pile entombed.

'Tis the Warder's key to cell Mysteries

Of which **Man** the Mystagogue fain' would be.

'Tis the real Solution-ary Power

Of the GREAT GOCEPTOR GOD that Is

By which HE most graciously transfuses,

And remotions, all impassioned matter,

Fitting it for its myriadal uses;

GOD AD LIBITUM AD INFINITUM,

AD MAJOREM DEI GLORIAM.

The **Chemistian's** knowledge is adoption,  
And practise, of the Chemist's Researches ;  
Genial lore that aptly finger points  
The summit of man's *ante-mortem* bliss :—  
Practise of all beneficent physical laws ;  
Fruitful tillage of the body and mind ;  
With high artistic Home and State amusements ;  
Such showers of delight will make all things bright,  
As Earth's creation by moist'ning summer rain,  
Leading to wise **curb'd-ignorance** legislation ;  
The composition and sale of Products  
On **International code of Honesty**,  
With the mingling of all men in union,  
God love, Commerce, and Race fraternity.

The Crown'd and Presidential Heads, through all this world,  
Should form one paramount popular Law

To instruct their Youth in some set digestion,  
A brief, terse, erudite minimum  
Of selected practical Chemical lore,  
Such, nominated and gen'rally recognised,  
Would justly elevate the parent science  
Above all presumptuous detraction.  
Chemistianity 's the glorious creed  
Whose benevolent aim for the body,  
Equals the Christian's love for the soul.  
By **gratitude for conquests o'er Matter,**  
With well preach'd soul's future dispensation,  
And memory-stored God's special acts of Grace,  
We are brought to the most harmonious condition  
For God's, and Christ's, true adoration :  
Chemistianity compulsory,  
Of physical knowledge chief over all,  
Imperative and unexceptional.  
The gainful effect of such Philanthropy

Would be provision against Youth's folly  
By sowing Spring wheat with their wild oats ;  
So, like rock-manure to unbudded germ,  
Provide for Maturity's growth of wit,  
And supply learning-force by which obtain  
The needful or devise the beautiful.  
Youth of ev'ry degree should thus be taught,  
Their erudition proved on set-a-part days,  
When folks that are young, aged, and disengaged,  
On pleasure, kindred-love, or learning bent  
May enter in and quest their brethren  
(With certain restrictions to chapter so).  
Then would public shame, honourable pride,  
And chemistian emulation,—forces Sirs,  
Most potent for the general weal,—  
Arrest and countercheck that baneful ghost,  
Inefficient, unqualified, Tuition.  
Their knowlege could be tested with sample Ores.



Grown, Chemical, and Meteor products,  
Kindly provided by the gifts of friends  
Or loans from public and private Museums.  
Registered marks, or instant awards,  
Would impulse to the full all meaning scholars,  
And, by such serving public recitals,  
Yield data for judging School Principals.

Writing and arithmetic first acquired  
Ev'ry Youth should learn, though like a gray parrot  
'Twere only by rote, the distinct features  
Of the Elements framing **The Universe**  
That each may dimly read the Hieroglyphics  
Which, in slow, medium, or flash time  
Are patent to our vision through Nature ;  
Be conversant with Native and Art products ;  
Con the diff'rence 'tween diff'rent non-yielding soils,  
With gen'ral principles of Agriculture ;

Be familiar with weather prognostics ;  
 The constituents of blood, bone, and muscle ;  
 Know reason of their waste and reconstruction ;  
 Thus making us wise in selection of food,  
 Choosing it to suit our temperament,  
 Occupation, climate, and condition :  
 For life current in the colder regions,  
 The avoidance, as staple aliment,  
 Of wishy-washy, scantily azotized,  
 Mushroomy produce from some slow manures.  
 Thus Marl-peat labour-youth with practical wit,  
 Tongue him with a Factor's queries and quips ;  
 The miner with circumstantial knowledge ;  
 If a farmer, rules to soil-tent his crops ;  
 The sailor, acquaint with air sea ruffles,  
 And travellers glibly spoken in all  
 With late news and successful instances.  
 Thus, all men Chemistianus, more Chemists will arise,

Daltonian-and-Columbian men  
Fill'd with Godly lore, whose noble studies,  
Amid a thousand various questions,  
Pursued in Virtue and Humility,  
Are researches as to **Primal Matter**.

Comprehension of **Molecular motion**.

To classify the first forms of Min'ral,  
Vegetable, and Insectile Life.

Report changes of surface on Planets  
In our 'mediate neighbourhood. Ascertain  
The different phases of life there existing,  
Foretaste as 'twere of our eternal glory.

Make **economic textile materials**,  
Plushy and downy, to Eider fowl warmth;

And gauze-y garments seemingly as light  
As Hydrogen Air. Such could be tinted  
With prism colours, transparent or opaque.

Compose a pocket **transparent waterproof**,  
A light **Glosser** to pack under dress leaf,  
Its expanded figure like bishop or cloak,  
Of pliant drapery, not eas'ly charr'd,  
To fully protect ladies' dressful charms  
From promiscuous home and tempest harms.  
'Twould aid to prove what our standard women are,  
Home-brilliant of choicest Earth purity,  
Whose luminosity is inborn worth  
Nourished by educated industry ;  
Their rays, to men, return'd from bus'ness toil,  
Are gleams of true **High** favour'd happiness.  
'Twere sweet, sociably sweet, to see a Dame

Finely attired, bishop'd in glosser frame ;  
A beauteous bud leaf'd by man's highest skill,  
Charm-ing by love-ert hands to free home from ill ;  
By her gracious presence first here, then there,  
Guiding and assisting in each chief care.  
She is at once class beauty beautified,  
Man's love and own Art duly glorified.  
There exists not on Earth a sweeter flower,  
Than virtued woman in soilless attire.  
Such a material would suit **many** uses.

**C**hemical knowledge may compound for us  
A fine setting statue-ary substance,  
Of plastic, carvable, hard, tenacious,  
And atmospheric-change resisting nature,  
To artistify our **home** furnishings  
And grandly decorate **public** buildings.

Make **instruments for sweet sound**, powerful and sweet,  
With wire or metal tubes diversely temper'd,  
Passed through varied menstrooms toned by Fluids  
Heated or cool'd, rarefied or compressed ;  
Like jerk'd pebble on thin ice, yielding dulcet sounds :  
Or vibrate tubes, as with Hydrogen [flame ;  
Producing voice-like or bird warbling notes  
By means, it may be, of electricity ;  
Through all guided by apt intelligence  
To sounds potential and harmonical,  
As your Boston jubilee Festival.

May produce a pocket, one-coin a sketch,  
Instant Photographic, **Mirror Peepetter**,  
For prompt **peepette** views—dear records for years—  
Of joyous meetings of friends and associates,  
Happy gath'ings, which were otherwise forgot ;  
Landscape scenes of home, school, and country ;

The last embrace from departing friends ;  
Mayhap prove place of faithless lover's vows ;  
Man's versatile friendship and humility  
In early worse-time days that, in after years,  
With modern int'rests, he would fain have sunk  
In oblivious rest. Thus would robed villainy  
Be checked, and pompous men kept shrewdly brave.  
'Twere most useful as preventer to crime ;  
For transcribing pages of costly books ;  
Re-glimpse of theatricals, public shows,  
Paintings of Art, and other mementoes.

**Enamel** for re-coating **decayed teeth**,  
Of character adhesive to moist surface,  
When duly set unchangeable by water  
And most fluid foods ; non-poisonous,  
And somewhat expansive. Such were a health' boon.

Make new **food compounds** from condition'd Elements;  
Produce new forms of vegetable life,  
Chance animal; mayhap may learn to rear  
All necessaries within small compass  
As doth the South Sea Islander, who yearly  
Supports himself and av'rage progeny,  
By produce from a dozen Bread-fruit trees.

In Scientific **Hospital Retreat**  
Show means to perpetuate the gush of life,  
Under exhaust, disease, or accident;  
By suited Atmospheres of purged air,  
Air oxygenated, ozonized,  
Or diluted with nascent Nitrogen;  
Perchance medicate them by vapour'd bodies;  
The gases may be stored in metal vessels  
Or exposed glass for Sun's direct effect,  
And breathed in darkness or full light in rooms,



Or coloured glass Domes with part reflective floors  
Form'd of smooth grit in which one can freely revel,  
Like a wallowing bird in sunn'd road dust.  
The Air may be compressed by pumps, or rarefied  
By heat as in your Turkish hot dry air bath ;  
Or reduced by ice, rendering latent heat ;  
And, at summer temp'ratures, saline-ing  
By dewy jets of pure Seawater.  
Such airs, for cause, might be electrified ;  
For wounds and with'ring flesh, blast of gases  
From stock-holders might be oft directed  
On limb through case-gear : the patient bathed and nursed  
With appropriate liquids and diet ;  
Perhaps may apply streams of young life blood.  
By effective studies **section'd chemists**  
May liven failing or check ailing flesh,  
The patients may repose in tremorless rooms  
In sweet retirement from the busy world ;

The monotony relieved by pleasant sounds,  
Of potioning clock-beat, chat of dear friends  
Or distant strains of concertial music ;  
Thus freed from adding cares of outer world,  
Invalids may recruit and rightly live.

By invention of cheap **Aqua Blaster**  
Which, started, will explosively gocept  
When in water, great tasks may be achieved,  
By breaking up for soil, sterile rock lands ;  
The dissolved substance of great gravity,  
Highly diffusive, and run into Faults,  
When gocepted under Wheeler Blowdome  
Will upheave strata and out-put treasure :  
The debris may be carbonized by moss culture,  
Or be used to fodder neighbouring lands.  
By intermittent dose we may pierce Earth  
And form Artesian Wells or product Mines :

At sea, remove heeling rocks from ship lanes  
To mariners the greatest of all banes.

By thorough knowledge of heat extraction  
We yet may freeze water extensively ;  
In double wall'd, tiled, and main drained alleys,  
Ice laid, or set with refrigerating tubes,  
Or inclined skate roads with freezing stations,  
Make ice roadways for goods and passengers ;  
By using trams skill-worked by vapour force  
Whose obedient strength on such slipp'ry paths  
Would swiftly impel to uttermost safe speed.

Chemists may suit a **caoutchouc-like body**,  
To Chlorine and Soda none corrosive,  
For the production of compact **float-belts**  
So form'd to wear unseen and be non cumbersome,  
By layer'd breast-bag charged with Chlorine trace,

Air tight, but permitting water entrance  
Through pressure-valve to weigh'd Sodium globule  
Which, immersed in water, would then gocept  
And fill aerial space with Hydrogen  
In such quantum as might support two persons.  
Such a substance, factor'd somewhat like gut,  
Could be made into a **life saver** rope  
Which, shot designedly from vessel's stern,  
To track of o'erboard seaman, would give him chance  
To regain his ship. This were our duty  
To least important scape-grace youth or man;  
Providence would fain see our heart intents,  
Accounts will be duly squared for such events.  
An economic Caoutchouc substitute  
Would make excellent **carriage composite**,  
For road or rail a splinterless carrier;  
In train mishaps a collision assuager;  
By extra buffers of such material,

Chance-medleys by rail would be much less fatal.

For louder vocal **trumpeting at sea,**

We may mountainize undulating voice waves

From most common e'en to musical staves.

Likely by union of Heat with Sound.

The tact may be acquired to **concentrate Light,**

In such force through lucid heat absorber,

That, with full darken'd good telescoped tube,

(The body being placed to interpose),

The living flesh of man may be transpared :

So by variedness in roseate hue,

Hints may be got to give curative cue.

May demonstrate if **Electricity**

Be Sun's light in condensed fluidity.

Start **springs of Electricity** from Earth,

Arrange their conduit, with safe restraint,

To fierce or moderate application ;  
Reduce rocks, which yield useful Elements,  
To present spectrum final substances ;  
Make trials, *per* and *pro* differing weathers,  
By electricity drawn through portable,  
Fire-escape, hollow Aluminium cylinders,  
In a series exposed and connectable :  
By **wire rods** led from mountain-peak to peak  
Per **U** shaped current lightning conductors ;  
By **windmills** with sheet Aluminium vanes,  
Having also broad metal roots through ground :  
For purposes and effects various.  
Form phosphorescent-like **Show-by-night sign plates**  
For miner's fixed guide Lights, and channel Buoys  
With conductor along the anchor chain,  
Illumed by frictional electricity,  
(As your instant **electric gas-lighter**),  
By clockwork made of Aluminium ;

Or, machinery motioned by the sea ;  
The beacon buoys placed in link'd chart series,  
Will constantly, as the moon forced tide tears on,  
Lustrate the channel course to wary seaman ;  
The tidal force may thus be made our servant,  
By peevish machines within fix'd hollow cones  
That, irritated by the water rush,  
May vent their rage in frictional Heat,  
Which, in turn, inveigles its associate,  
Man's true slave, docile Powerful Matter

Matter—as Earth—in plain fan-facial telegrams  
Seemeth to say, agitate me ignorantly  
Through ponderous masses and my cert Laws  
May bring about man's partial destruction.  
Oh Man ! the CAUSE scanner, and GOCEPTOR-allied,  
COMPOUND factor, and ELEMENT re-'ranger  
Yet imperial arrogant trickster,

How often, on seeing thy hawk malignity  
To thy thinner law-feathered brethren,  
Have I almost staggered in my courses,  
Long'd but for word to thunder out my wrath,  
To open craters and by lava eruptions,  
Or foul gas emissions to succumb thee.  
Such is Justice in some days (to wit, the present)  
Truth and Honesty have but air value;  
Equity and human life are debased  
As if ignorant of man's **Endowment**;  
Men fight whose shadows should cloud my land  
And irrigate the soil with **God's treasure-trove**,  
Severing His souls from their formal ties.

**Study my substance**

In quiet diligence and Godly awe,  
Chronicle my motions with precision,  
And I'll unravel great agglomerate lore



Evidencing by proofs and logic reas'ning ;  
Upheave my rocks and unfold each stratum ;  
Search close on the verge of the heat abyss ;  
Quest the scoria from my inner self ;  
Research with fine scansion, and bethink you well,  
For I'll discover such learning to thee  
Of which as yet thou hast scarce an inkling ;  
I will power thee to quickly tunnel mountains ;  
Cooper sea-sucked lands, and fruit barren plains ;  
Impel thee swiftly o'er undulatory sea ;  
And will aid thee in celestial searching  
In greater degree to mightily eye-bridge space.  
In construing Nature, don't misconstrue,  
Thy soul will tell thee that or that is true  
Or define as being beyond thy thought ;  
Unless, indeed, thou never quest thy soul  
But ramble on in shallow sapless wit.  
Likeliness of your earth to other earth

Doth not detract from your high attribute ;  
Thy gifted power to facsimile  
Proves thy kinship to **THE SIMILITOR**.  
No creation in all **THE MATTER SEA**  
Hath a pale of worth to that one Great Work  
Christ's expurgation of **sub-earth-will**.  
If this time-brief world may man yet observe,  
Contra faith-trying contrarieties,  
High nature-al Laws, enforced Rectitude.  
With soaring love to the **SAVIOUR of MAN**.

Let us do all things possible within our sphere,  
In low imitate of **The Goceptor** ;  
With worth and probity we will progress,  
In Trade, with motto,—Equity to all men ;  
In Science—Research for Beneficence :  
In Religion—Excelsior Charity :

These aims, conjoined, form the highest Earth bliss,  
In such like duties let none be remiss,  
But through our curt time let ev'ry one strive  
His quota to add to make happy live,  
Until, at early age, by passing cloud  
We are shaded out of this existence,  
And pass into a more enduring state,  
To wit—Eternity, or wheel of years,  
As the vibrates of molecular motion  
Through all space, even so uncountable.



THE SIMPLE SUBSTANCES

CONSTITUTING

MATERIAL BEING:

WITH

NATURAL LAWS AND ART PROCESSES.





# SIMPLE SUBSTANCES,

WITH

NATURAL LAWS AND ART PROCESSES.



**MATTER**, is the body of the Universe,  
That, by the aid of Chemical Science,  
With the best of all known appliances,  
Has been resolved into **Sixty-three** bodies  
(Or conditions of free, real essence)  
Term'd **ELEMENTS**, or Simple Substances ;  
These, we have been unable to split up,  
Or subdivide, into more Primal being.

---

The following list,  
Is based on Chemist Frankland's division  
Of the Elements ; twenty **Metalloids**,

Named in order of their combining weights,  
 And forty-three known, proved, real **Metals**,  
 Arranged under Chemist Roscoe's system,  
 By classing in **ten families** or **Klans** ;  
 The bodies appertaining to each Klan  
 Are writ in order of their combining weight  
 Or type of their Chemical energy.

### M E T A L L O I D S .

Hydrogen, Boron, Carbon, Nitrogen,  
 Oxygen, Fluorine, Silicon, Phosphorus,  
 Sulphur, Chlorine, Titanium, Vanadium,  
 Arsenic, Selenium, Bromine, Tin,  
 Antimony, Iodine, Tellurium,  
 And Bismuth.

### M E T A L S .

#### 1st Klan.

Lithium, Sodium, Potassium,  
 Rubidium, and Cæsium.

#### 2nd Klan.

Calcium, Strontium, and Barium.



## 3rd Klan.

Aluminium, Yttrium, Cerium,  
Lanthanum, Didymium, and Erbium.

## 4th Klan.

Beryllium, Magnesium, Zinc,  
Indium, and Cadmium.

## 5th Klan.

Chromium, Manganese, Iron,  
Cobalt, Nickel, and Uranium.

## 6th Klan.

Zirconium, Niobium, Tantalum,  
And Thorium.

## 7th Klan.

Molybdenum, and Tungsten.

## 8th Klan.

Thallium, and Lead.

## 9th Klan.

Copper, Silver, and Mercury.

## 10th Klan.

**Rhodium, Ruthenium, Palladium,  
Gold, Platinum, Iridium, and Osmium.**

---

It has been found, by close observation,  
That these Elements (Simple Substances),  
Are **indestructible**, do what we will  
By pressure, attenuation, heat, or cold,  
They are, to present sense, insolvable.  
To name one of them echoes—simple substance.

---

COMPOUND BODIES are two or more Elements  
Chemically combined with each other ;  
Though resolvable to their simple forms  
They appear to have new-born faculties.  
The whole **Earth** nearly is composed of such compounds,  
Which we can unmake, amongst others—  
Water—to Hydrogen and Oxygen ;  
Chalk—to Oxygen, Carbon, and Calcium ;  
Sugar—to Hydrogen, Oxygen, and Carbon ;  
Copper Sulphide—to Sulphur and Copper ;  
And, Common Salt—to Chlorine and Sodium.  
One proof is seen with Mercury Oxide

By heating in test tube over gas flame ;

Oxygen is freed, and Mercury sublimes

In metallic state at the cold end of tube.

By repeating such trials, carefully,

In proper vessels, and weighing products,

**Their conjoined weights equal weight of compound.**

---

A MECHANICAL MIXTURE consists of elements,

Or compounds of elements, placed side by side

Inactive though in a mingled condition :

The microscope often proves their uncombined condition.

If heat be applied to some such mixtures

It will frequently commence Goception.

---

CHEMICAL ACTION, in brief \*Goception,

Is the motion which occurs between substances

Brought together and producing new Compounds.

They often have widely different properties

To the primary substances employed.

Substances undergo Goception thus :—

By direct union of elements,

Or groups of elements, with each other.

By displacing one element, or one group

\* From Gang—to pass, either to come or go : and præcipio, to command.

Of elements composing a substance,  
With other element or other group.  
By mutual exchange, between mingled bodies,  
Of elements or groups of elements.  
By re-arrangement of the elements,  
Or groups, already within a substance.  
By resolving a compound, to simple  
Elements, or two or more less complex forms.  
Goception is evinced when burning Candles,  
Coals, or distilling Coals for Household Gas ;  
By burning Limestone ; and, by slaking Lime.  
Elements that unite with each other  
Do so in mathematical ratio ;  
The precise agreeing weights or proportions  
In which they intermingle is tabled  
As the COMBINING WEIGHTS or Proportions.  
An Atom is such a small particle of matter  
As is considered chemically indivisible  
And to be the smallest portion of a body  
That can enter into a chemical compound.  
A MOLECULE is the smallest particle  
Of an element which can exist free ;

It consists usually of a group of Atoms ;  
Most gaseous elements contain two Atoms ;  
Ars'nic contains four Atoms in molecule ;  
The molecule of some volatile metals  
Contains only one Atom, in which case  
The molecular equals the atomic weight.  
To describe an actual chemical change,  
Use should be made of the molecular formula,  
Though frequently, for simplicity's sake,  
The atomic formula is used.

---

The simple Atoms of an element,  
At moment of freedom from a compound,  
Unite and form a molecule  
Of that free element. If haply  
Another body should be present,  
With which the element can gocept,  
It is decomposed by the chemical  
Attractions of the liberated Atom.  
The Atoms of an element just freed,  
Are most active at the moment before  
They group themselves into a molecule ;  
At this time they are said to be **nascent**.

---

A **SOLUTION** is the perfect union  
Of a body, gaseous, liquid, or solid,  
With a fluid, forming a **uniform liquid**.

A **Solvent** is a fluid that dissolves bodies.

In a "**simple solution**," no action  
Takes place beyond mechanical union ;  
As instance,—Common Salt mix'd with Water.

Adding so much substance to a liquid  
That it dissolves no more, is term'd SATURATION.

An **ALKALINE** body turns red litmus paper blue  
And yellow Turmeric paper to brown ;

It also combines freely with Acids,  
Finally neutralizing them completely.

**ALKALINE** OR **BASIC OXIDES** are such  
As resemble Oxides of Sodium, Potassium,  
Silver, or Lead, in chemical relations.

Acids turn blue litmus paper red ;  
They all contain Hydrogen allied  
With one or more Elements ; if Oxygen  
Be also present they are call'd Oxi-acids.

**ACID OXIDES** are those like Phosphorus  
Or Sulphur Oxides ; with **basic Oxides**

They can unite and form compounds call'd SALTS.

A DIBASIC ACID such as Sulphurous Acid

Contains two atoms of Hydrogen

Each of which can be replaced by metals ;

In Acid Salts one atom is replaced ;

In Neutral Salts both atoms are replaced.

NEUTRAL OXIDES, as Manganese Black Oxide,

Are intermediate, with weak combining force ;

These Oxides sometimes verge into each other,

And the same Oxide be Acid or Basic

According to diff'rent circumstances.

HYDROGEN SALTS, are special class of Salts,

They mostly contain elements of an Acid Oxide

And Water (Hydrogen Monoxide). The term Acid

Is specially applied to them because

They have, mostly, sour taste and corrosive action.

Acids, or Hydrogen Salts, usually give up

Their Hydrogen for Metal if presented

In state of Metal, Oxide, or Hydrate.

Zinc and Sulphuric Acid make Zinc Sulphate ;

Zinc Sulphate 's formed in lieu of Hydrogen Sulphate

By the substitution of Zinc for Hydrogen,



Hydrogen being evolved in the free state :

The Zinc **Oxide** and Sulphuric Acid

Make the same Salt, but the Oxide's Oxygen

Claiming the Hydrogen to form Water

There is no escape of free Hydrogen.

---

“CRYSTALLIZATION” and “PRECIPITATION”

Are crab-motional processes compared

To Solution ; they bring the Solid back

From the fluid or dissolved condition.

---

All **crystals** are elements, or compounds,

Which have assumed a geometrical form ;

Many may be Art-form'd by Heat,—as Sulphur,

Or Lead, melted and slowly cool'd ; or Iron

At time of casting at a Foundry :—which see.

By s u b l i m i n g volatile substances,

As Iodine or Arsenic Trioxide

Heated in glass tube ; the crystals form at cool end.

By s o l v e n t s , as Salt or Nitre dissolved

In Water, boiled to saturated state,

Then allowed to cool and arrange itself :

The unset liquor is called **Mother Liquor**.

Nature's own process of forming crystals



Existing in Minerals and Plant cells,

As yet is not perfectly understood.

---

Crystals belong to one of six systems ;

**First, or Regular System,** like Alum,

Common Salt, Iron Pyrites, or Fluor-Spar.

**Second, or Quadratic System,** like Tin Dioxide

Or the Yellow Prussiate of Potash.

**Third, or Hexagonal System,** like Quartz,

Calc Spar, or Ice as seen in Snow crystals.

**Fourth, or Rhombic System,** like Native Sulphur,

Barium Sulphate, or Common Nitre.

**Fifth, or Monoclinic System,** like Borax,

Sodium Carbonate, or Cane Sugar.

**Sixth, or Triclinic System,** like Copper Sulphate,

Boric Acid, or Potassium Bichromate.

---

The non-crystalline arrangement in Plants

And Animals, is term'd **Cellular Structure.**

---

Substances of no set shape are **Amorphous** ;

Such is Glass, Glue, or Silicate of Lead.

---

When the same body occurs crystallized

In more than one system, it's **Dimorphous** ;

Crystals from native Sulphur and Sulphur

From fusion, are of two different systems.

Some substances are much like each other

In arrangement of chemical elements,

And, as they crystallize in the same form,

They are call'd ISOMORPHOUS with each other ;

The Salts of Potassium Hydroxide

And Thallium Hydroxide are isomorphous.

Precipitates are substances thrown down

From a solution, by modifying

The solvent,—as, adding to Lime Sulphate

Dissolved in Water, common Alcohol ;

The Lime Sulphate precipitates as powder.

By separating solid educt

Insoluble in the liquid, as Zinc

Placed in solution of Copper Chloride ;

The Copper in metallic state settles down.

Or, by adding sundry Chemical liquids

Which, by affinity, form new compounds ;—

As, Oxalic Acid with solution

Of Acetate of Lime ; white Oxalate

Of Lime precipitates. It may happen,

That the water may be left free and pure,

As with solution of Silver Sulphate  
Added to solution of Barium Chloride ;  
The two compounds gocept and precipitate.

WASHING chemical substances is perform'd  
Chiefly by a g i t a t i o n with Water ;  
Or d i s p l a c e m e n t by pressure of Water  
Above, or from below, the mass on filter.

DECANTATION is the act of p o u r i n g  
Liquids gently from off their sediments ;  
'Tis sometimes performed with Pipette or Syphon,  
(Tubes for Air-pressing out the clear liquor.)

FILTRATION consists in s e p a r a t i n g  
Solid matters suspended in liquids  
By sieving through unsized Paper, Hâir bale-cloth,  
Sponge, Charcoal, Sand, Pebbles, Cinders, or Coke.

DIALYSIS is the s e p a r a t i o n ,  
Whilst in liquid state, of crystalline bodies  
(Crystalloids), from non-crystalline bodies  
(Colloids), such as Salt from Tannin,  
By placing their mix'd solution on Skin,  
Or Parchment-paper, lying on water ;  
Crystalloids go through, leaving the Colloids.

EVAPORATION is the separation  
Of volatile from less volatile matter,  
For obtaining a wished for residue;  
Generally by application of heat,—  
As, by boiling off water from solutions  
In Glass vessels, Steam or Fire heated pans.  
By placing a fluid in an Air current  
And exposing to Sun's heat under a glass Shed.  
By keeping in enclosed volume of Air  
Kept dry by Hygroscopic substances  
(Water vapour absorbers), as strong Vitriol,  
Or dry Calcium Chloride, exposed in flat vessels.  
And by placing fluids in Rarefied Air  
Kept dry by Hygroscopic substances.

---

DISTILLATION is the separation  
Of volatile from less volatile matter,  
For recov'ring the evaporated fluid;  
It is perform'd by heating the liquids  
In Copper Stills, Clay, Glass, or Iron Retorts  
And leading the educted vapour to tubes  
(Condensers) cool'd by Air, Water, or Ice;  
The pipes or tubes are joined to a Receiver.

SUBLIMATION is the same to **Solids**

As distillation is to Liquids ;

It separates more volatile bodies

From less volatile, or fix'd, substances,

The S u b l i m a t e , or evap'rated body,

Being the chief desirable solid :

It's perform'd by placing the mix'd substance

In closed vessel, such as a sealed glass tube,

Dome-shaped earthenware or Still-like Iron Pan,

And **heating** one end of vessel only,

The other end being cool'd by Air or Ice :

The sublimate settles on the cold end of Still.

---

FUSION is the conversion of Solids

To Liquids by application of **heat** ;

It is perform'd in one-outlet glass tubes,

Metal-, Hessian-, or Clay-, crucibles ;

They are heated in a gas flame, or furnace.

Fusion aids goception in solid matter

By combining or decomposing bodies.

The process is often assisted by “ **Flux**”

(Another substance added to assist

Liquefaction at high temperature).

---

When bodies become of intense white heat  
 They are **incandescent** or **ignited** ;  
 If such bodies whilst in a heated state  
 Are acted upon by surrounding Air  
 They are in a state of **COMBUSTION**,  
 Literally, heat-producing goception :  
 Some bodies absorb Oxygen—as Phosphorus  
 And Aluminium—forming solid Oxides ;  
 Others take up Oxygen—as Carbon and Sulphur—  
 Forming volatile Gaseous Oxides.  
 Many bodies in active goception  
 Become mod'rately heated and luminous.  
 The **Heat** liberated may be referred  
 To the act of Chemical union,  
 (In ordinary Coal, Peat, and Wood fires,  
 Of Oxygen with Carbon and Hydrogen) ;  
 And **Light** as the result of the high temperature.  
 Chimney draughts, Bellows, Fans, and Hot-air blasts,  
 Are our present best Air-Oxygen collectors.

---

\* **IGNITION** is in a sense to **Solids**

What evaporation is to **Liquids** ;

It separates more volatile bodies

\* As a technical process.

From less volatile or fix'd substances,  
The residue only being important :  
It's perform'd by exposing the substance  
In strong Glass tube, Porcelain dish, Platinum-,  
Plumbago-, or Clay-, crucibles, or Furnace,  
To **high heat** by Gas, Char, Coke, or Compound flame,

DEFLAGRATION is somewhat noisy goception ;

It is produced by heating certain substances

With a Nitrate or a Chlorate Salt ;

The latter body is robbed of its Oxygen.

CUPELLATION is a mode of refining metals

Chiefly Gold or Silver when mixed with Lead ;

The mixed metals are placed, within a furnace,

In cups (Cupels) or Bed composed of burnt Bones,

Or Lime Phosphate, shaped in moulds by pressure ;

On heating, the dross metal becomes fluid, oxides,

And sinks within the body of Cupel

Leaving the rare metal in a pure state.

IN REVERBERATORY FURNACES,

Where substances may receive intense heat

Out of contact with fuel, the fire-space

Is separated from the furnace-bed, or hearth,



(On which the Ores or Substances are placed),  
By a bridge, or low wall, of fire-brick work ;  
O'er this the flame is drawn by chimney-draught :  
The roof of furnace being of arch'd form

**Flame** and **hot air** are thus well reflected  
( R e v e r b e r a t e d ) to substance on hearth.

The OXY-HYDROGEN BLOWPIPE FLAME is produced  
By combining at a desired jet point  
And igniting, a stream of H y d r o g e n  
With a stream, half its 'quantum, of O x y g e n ,  
Each directed with care from distinct gas holders ;  
The heat produced being very intense  
It melts nearly all metals with facility.

Iron wire, or small Steel file, scintillates  
In flame of this blowpipe with great splendour ;  
Lime, or Magnesia, ignited in the mix'd gases  
Glows with an intensely vivid light,

The former is well known as the **Lime Light**.

ELECTROLYSIS is the d e c o m p o s i t i o n  
Of substances by an electric current :

For metals, the carefully prepared **Chloride Salt**  
Is chiefly used ; when it is l i q u i f i e d by heat



The terminals of a working Battery  
Are placed in the liquid (**E**lectrolyte) ;  
Chlorine goes to the positive, and metal  
To the negative, terminal of Battery.

---

The SPECTROSCOPE is of immense service  
In showing a characteristic feature  
In most Elements when in combustion ;  
By it is perform'd SPECTRUM ANALYSIS  
Which consists in letting rays of colour'd flame  
(Produced when the substance to be examined  
Is ignited in a colourless flame)  
Pass through a narrow slit, then through a **p**rism,  
And observing the so refracted rays  
Through a specially arranged telescope,  
Each flame colouring element has its distinct  
S p e c t r u m . Thallium shows a single green line ;  
Baryta a number of colour'd lines  
Lying side by side ; Lithia has two  
Separate and diff'rently colour'd lines.  
These Spectrum lines have distinctive colours ,  
And also occupy a fixed position ;  
The Spectroscope thus gives certain instant proofs.

AN **Ultimate Chemical ANALYSIS**,  
Is to take Compounds and determine the weights  
Of their ultimate Elements, usually,  
When reduced to simpler combinations.

The **Qualitative** and **Quantitative**  
Analysis terms are self expressive.

SYNTHESIS is producing a substance  
By construction from its elements.

Freed gases, whether Simples or Compounds,  
When they do not combine with Goception,  
Will diffuse themselves through each other's space,  
With almost life-like force. This property  
Is call'd the **Diffusive power of Gases**,  
Nature's sure, slowly acting, sanitary law  
For purifying the Air of houses and towns.

Gases will creep through the pores of some solids  
That compose a dividing wall in one vessel  
In order to mingle with one another ;  
The rate of mixing, call'd the **Velocity**  
**Of diffusion of different gases**,  
Is inversely proportional to the square root  
Of their densities. Vide a tabled list.

The solution of gases in water  
Or in other liquids is called ABSORPTION  
Unless the solution of gas or gases  
Should produce a known chemical compound.  
Water will dissolve the same gas, at different heats  
And pressures, in variable proportions.  
Some gases will withstand applied pressure  
Much better than others. In case of mix'd gases,  
As Air, subject to pressure o'er water,  
The solvency 's out of ratio to pressure ;  
Thus Water dissolves Oxygen, from Air,  
More abundantly than it does Nitrogen.  
Liquids, when freezing, lose much of the gas  
They weakly hold, hence the Air-bubbles in Ice.

---

**Weight of Gas** is judged by measuring its volume  
By the Metric (French Decimal) System  
Of weights and measures. The standard **metre**,  
Preserved at Paris, in length, is a trifle less  
Than thirty-nine and a half English inches,  
(Nearly one ten-millionth of the distance  
Measured from the Pole to the Equator.)  
One cubic centimetre of pure water

At four degrees temp'rature Centigrade  
Was weigh'd at Paris and named **Gramme** or **Gram**.  
This weight is divided, as is the standard metre,  
Into tenths, hundredths, and thousandths.  
The pressure exerted by our atmosphere  
Is measured by BAROMETER, an instrument  
That is often made thus :—A straight glass tube,  
Thirty six inches in length, and seal'd at one end  
By the blowpipe flame, is fill'd with dry Merc'ry ;  
The full tube, with open end stopped by finger,  
Is inverted in a basin of Mercury,  
When the finger is removed the Merc'ry in tube  
Sinks to a column thirty inches in height,  
Above the surface of Merc'ry in vessel  
(Or about that height if placed at the Sea-level),  
Leaving a vacant space at the top of the tube.  
The tube is then furnished with wood or métal scale  
Divided into inches and tenths of inches.  
The Merc'ry in tube sinks one tenth of an inch  
For each rise of one hundred feet above the sea.  
The Barometer 's used to measure heights of mountains  
And for denoting changes of weather.

**Gases** are elastic ; put on pressure

And they go less, remove and they increase.

**Liquids** are compressible to a slight extent.

Solids and Liquids all expand diff'rently ;

The expansion of all gases by heat

(Taken at common pressure of our Air)

Is very nearly equal ; Hydrogen

Expands less than atmospheric Air, and Air

A trifle less than Carbonic Acid Gas ;

But, for ordinary proofs, each volume swells

One two-hundred-and-seventy-third part larger

With each degree of heat, starting at Zero :

Cooling shrinks the gases in same ratio.

A decimal fraction equals this rate

Call'd the GAS EXPANSION'S CO-EFFICIENT.

In comparing diff'rent bulks of gases,

The standard temp'rature and pressure are noted.

The SPECIFIC GRAVITY of a gas,

Is ascertained by filling a large glass globe,

With the pure dry gas at a known temp'rature

And elastic force equal at the time

To that of the Air ; the full globe is weighed,

Then, exhausted by air-pump, is again weighed,  
 'Tis then filled with dry Air, heat and pressure known,  
 And again weighed: **the weight** of Gas divided  
By that of Air, gives the Specific Gravity.

An ATMOLYSER is an arrangement  
 For separating light from dense mix'd gases,  
 By percolation or rarification  
 Of the lightest gas, through a porous tube  
 Which passes through a whole or partial Air vacuum :  
Air when Atmolysed yields Nitrogen.

OSMOSE is the mode of gas diffusion  
 Play'd by the lungs during respiration ;  
 'Tis imitated when gas is passed through Skin,  
 Caoutchouc, or Bladder : the gases diffuse  
 On two rules—their adhesiveness to membrane,  
 And their light or diffusive nature ;  
 The gas most adhesive, usually,  
 Passes through membrane the most readily.  
 Owing to solubility of some gases,  
 In water of skin, the process is hastened  
 By keeping the skin or membrane in a damp state.  
 The Osmose process, through a free moisture,



Seems like the liquefaction of gas *pro tem*,  
 Then, permeating through the substance of membrane,  
 It vaporates as gas on other side.

Oxygen passes freer than Nitrogen  
 Through wet Caoutchouc. A vacuum assists Osmose.

---

Metals also possess a faculty  
 Of liquefying and absorbing gas ;  
 Such absorption by metals is term'd Occlusion.

---

LATENT HEAT, as in water, is the force  
 Known to be innate self-concealed.  
 When Water solidifies, or freezes,  
 The force which kept the water liquid (in error  
 Term'd **Heat of Fluidity**), is evolved  
 And dissipated to surrounding matter. .

When water passes from solid to liquid state  
 An equal amount of force is absorbed,  
 (The heat of fluidity 's again imbibed  
 From surrounding matter, and latent.)

All bodies passing from the solid state  
 To liquid, absorb this force but, conversely,  
 Lose it again when solidifying.

---

ISOMERISM is a term which denotes

The same percentage composition of compounds  
Of Carbon, and also other Elements,  
But which, chemically, and physically,  
Act differently from one another.

AMALGAMS are unions of certain metals,  
Or metalloids,—as Gold, Silver, Lead, Tin,  
Or Arsenic—with Mercury ;

The Mercury is often recovered  
From the other bodies by distillation.

QUANTIVALENCE OR EQUIVALENCY

Expresses an Atomic rule in combining,  
Elements of even equivalency

Have the general name of ARTIADS :

Such are the Dyads,—Bivalent Elements ;

Tetrads,—Quadrivalent Elements ;

And Hexads,—Sexvalent Elements.

Elements of uneven equivalency

Have the general name of PERISSADS :

Such are the Monads, or Univalent Elements ;

The Triads, or Trivalent Elements ;

And Pentads, or Quinquivalent Elements.



AN

ORATORICAL VERSE

ON EACH OF

THE ELEMENTS.





## THE FIRST GROUP OF ELEMENTS.

### METALLOIDS.

\*ABGEN.

**HYDROGEN**, the chief Stellar element,  
The lightest body known in Creation,  
Is a colourless, odourless, and tasteless  
Metalloid, existing in a gaseous  
Or aeriform condition. No pressure  
We know as yet will liquify this gas;  
It is easily enkindled, evolving  
Great heat, but little light with pale yellowish flame  
And formation of **Water** whilst burning in Air.  
The flame from Hydrogen-jet is excellent  
For **sound** experiments; with long glass tube  
The vibrations produce a musical tone.

\*Vide Appendix.

Hydrogen passed over Copper Oxide  
Heated to redness, forms pure Water,  
And leaves the Copper in metallic state.  
Hydrogen when mix'd with half its volume  
Of Oxygen, burns in jet with intense heat;  
If the gases are ignited within vessel,  
They **explode** and unite with great violence.  
When burning mix'd Hydrogen and Oxygen,  
The flame is **solid**—not hollow like common flame.  
Hydrogen in trace dissolves in Water;  
It is not pois'nous, yet will not support  
What we at present distinguish as—Life.  
Hydrogen has high diffusive power,  
And should not be kept for long period  
In bags or holders, for fear of leakage  
And formation of explosive mixture.  
Hydrogen will penetrate Platinum,  
And iron tubes, whilst exposed to a red heat,  
And may then be said to be "**occluded.**"  
Finely divided, or roll'd plate Platinum  
Will condense and unite the mix'd gases,  
(Two of Hydrogen and one of Oxygen),

In the cold state and without violence,  
Producing Water in the form of Dew.  
Palladium, Gold, Stones, and even Glass,  
Though sometimes requiring the aid of heat,  
Possess the same power to a less degree.  
Platinum-foil with thoroughly cleansed surface,  
Dipp'd in a mixture of the two gases,  
Immediately gocepts them, producing  
Water, and heat sometimes to red heat of foil.  
The gases are supposed to have power  
To densify, perhaps to liquify,  
On surface of a non-oxidizing metal,  
And, whilst in that state, to chemically combine.  
Hydrogen forms two compounds with Oxygen,  
Water—known as Hydrogen Monoxide,  
And, the art form'd Hydrogen Dioxide.  
Water, consisting of Hydrogen Gas  
Two volumes, with one volume of Oxygen,  
When combined and in vapour, the three volumes  
Are condensed into two volumes.  
Water, **by weight**, contains of Hydrogen  
One part, and of Oxygen eight parts.

Water, acidulated, is decomposed,  
By voltaic Electricity,  
To pure Hydrogen and pure Oxygen;  
It is also decomposed by great heat.  
The two gases can be re-united,  
By placing mixture in glass tube o'er Merc'ry,  
Or in Cavendish's exploding vessel,  
And start goception by Electric spark.  
Water in small quantum is colourless,  
In mass it is blue like the Atmosphere,  
As seen in the azure tint of Sea, Lakes,  
In Lake-rivers flowing deep pure water,  
And in Clefts and Caverns through glacier Ice.  
In nature, warm Air dissolves Water as vapour,  
Taking it from Sea and all exposed moisture,  
Rising with it, in invisible form,  
To high Air currents in our Atmosphere:  
Its partial, and near whole, condensation  
Depends on the cooling of these Air streams,  
Hence are form'd **Clouds** (agglomerated moisture)  
**Dew, Mist, Fog, Rain, Sleet, Snow,** and ice grain'd **Hail.**  
Water is never found pure in nature:

Rain,—contains trace of Ammonia Salts,  
Common Salt and also organic matter ;  
Springs, Rivers, and Seas,—Saline and Life matter.  
Water distilled in Aluminium, Tin,  
Or Silver vessels yields pure water.  
The Ocean, or great Salt Lake, is the vast  
Depository in which solvent bodies,  
Wash'd down from rocks and soils by mountain rain,  
Spate, torrents, and rivers, are collected.  
Water, in this a spirit of destruction,  
Lays down his load, and hies, like Bee, again to task.  
The principal Salts found in Sea-water  
Are compounds of Sodium, Potassium,  
Magnesium, Calcium, Chlorine, Bromine,  
With Iodine and Ammonium in trace :  
Heat of climate, large Rivers, and Ice-fields,  
Alter the composition of Sea-waters.  
Spring-waters differ by passing through Rocks  
Containing Iron, Carbonic Acid Salts,  
Soluble Alkali, Iodine, or Bromine.  
Their heat varies through their deep or shallow source.  
**Hot Water**, generally, dissolves bodies

Better than cold. Lime and Salt are exceptions.  
In time, Steam at high pressure corrodes Glass,  
And Felspathic Rocks,—as in Geyser Springs.  
Water absorbs most gases in bulk or trace,  
According to pressure, heat, and purity, of gas.  
The Air dissolved in Water is richer  
In Oxygen than is Atmospheric Air;  
Pure Water absorbs more than Saline Water.  
Water when freezing retains but such gas  
As makes with it a known chemical compound,  
As instance, the frozen Chlorine Hydrate.  
Water forms direct compounds with some bodies.  
In such cases much heat is frequently evolved  
As known by slaking Lime. The union  
Is oftentimes so true that no heat will separate.  
The Potash and Soda Hydrates are faithful.  
The water contained in many crystals,  
Call'd the **Water of Crystallization**,  
In general, heat will quickly dispel.  
Water is found in nature in gaseous  
Or vapour form,—as Steam and Air-moisture;  
Liquid,—as Water; and Solid,—as Ice.



In liquid, or ice form, it's volatile  
At any degree of temperature ;  
This power to rise in vapour is call'd  
Its **elastic force** or **vapour tension**.  
Water boils when the tension of its vapour  
Is equal to the atmospheric pressure.  
Water boils easily on mountain top,  
Owing to decrease of the air pressure.  
It expands, on freezing, one eleventh part ;  
This force accounts for **rock-splitting** during Winter.  
The **Latent heat of Water** is seventy-nine  
Thermal units. A vessel of water,  
If perfectly motionless, can be cool'd  
To below freezing point without freezing ;  
But agitation, no matter how slight,  
Causes an evolution of fluid heat,  
Ice is form'd, and the heat of water raised.  
Cooling from four to nought degrees centigrade  
Water expands ! Heating from nought to four  
It contracts ! It is thus an elastic force  
Which may yet receive an Art application :  
Upon this exception to the law of contraction

By cold, depends the mildness of our climate :  
Seawater does not follow this exception ;  
Fresh Water's greatest density is **four** degrees ;  
Above or below that heat it is lighter ;  
Therefore, when freezing, water at that heat sinks,  
And water at nought degrees floats and forms Ice :  
However cold the surface water becomes,  
It cannot sink below the dense water  
(Water at four degrees Centigrade) :  
Thus our rivers, and lakes, are prevented  
From forming ice-bergs which our summers could not melt.  
The temperature of water may be reduced,  
By rapid evaporation, to extent  
Of converting it into solid Ice,  
As evidenced in some Freezing-machines :  
By pumping the vapour from over water,  
And passing it over strong Vitriol,  
The vapour absorbs the heat of water  
So completely, that the residue forms Ice.  
Water when converted by heat to Steam,  
Absorbs (latents) within itself much heat ;  
On cooling, this heat is freely disengaged,

A fact largely made use of in the Arts.  
A cubic inch of water, changed to Steam,  
Expands to near **seventeen hundred inches**.  
Hydrogen occurs in **occluded** form  
In the meteoric "Iron of Lenarto ;"  
By that, and Spectrum Analysis proofs,  
Hydrogen is considered to form **Atmosphere**  
In many Stars ; **Chromosphere** of our Sun,  
And **vapour** in Nebulæ. Hydrogen  
In occluded, or solid form, is call'd  
**Hydrogenium** : it then conducts heat,  
Electricity, and is magnetic.  
Hydrogen is, from this fact, presumed  
To be a highly volatile metal  
In the state of **attenuated vapour**.  
Hydrogen exists in vast quantity,  
Combined as Water ; in almost every  
Vegetable and Animal substance ;  
In many minerals ; and, in the free state,  
In the **gas emissions** from Volcanoes.  
Hydrogen Dioxide (**Oxygenated Water**)  
Is a limpid and odourless liquid,

It's decomposed by low heat, and with violence  
At one hundred degrees Centigrade :  
Of Oxygen, it has twice as much as Water  
By weight—sixteen parts to one part Hydrogen ;  
It is prepared from Barium Dioxide  
By dissolving in Hydrochloric Acid,  
Cool'd by Ice, and precipitating Barium  
(By adding dilute Sulphuric Acid)  
As Sulphate ; the Hydrogen Dioxide  
Is form'd, and dissolved in the Acid Water.  
Hydrogen may be obtained from Water,  
By passing Steam over Iron filings  
Exposed to red heat, within an Iron tube ;  
Iron Oxide is form'd and Hydrogen freed :  
The gas is collected over water.  
A better method to prepare Hydrogen,  
Is by decomposing diluted Acid,  
As Sulphuric, by adding scrap or strip Zinc ;  
Hydrogen begins at once to free itself  
And may be collected, over water,  
Into " Bell glass," large or small Gasholder,  
Or, by displacement, by inverting bottle

Over narrow mouth of producing vessel.  
Hydrogen Dioxide possesses  
Remarkable bleaching properties.  
Hydrogen Trioxide, a doubtful compound,  
Is much like the Hydrogen Dioxide  
For appearance and bleaching properties.  
Hydrogen, when pure, is the most buoyant gas  
For inflating Air Balloons ; but Coal Gas,  
Specially made at a high temp'rature,  
(Hydrogen in gaseous compounds), is now used.  
A jet of Hydrogen, if directed  
On to dry spongy Platinum, will ignite,  
Producing a machine for "**Instantaneous Light.**"

## AMYAN.

**BORON**, combined, used in forming Art Gems,  
Is a metalloid of dull greenish-brown hue,  
When burnt in Air, it forms Boric Oxide.  
Boron, red hot, will absorb Nitrogen,  
And, at the same time, emit bright white light.  
It forms compounds with Alkalies, Acids,  
Chlorine, Sulphur, and other Elements.  
Its Potassic Fluoride Salt, when fused

With Sodium and Zinc, yields fine crystals  
Very like Silicon's diamond-imitate:  
These Boron crystals are square octohedrons,  
Of brown tinge, hard and refractive like diamond,  
Infusible by Oxy-hydrogen flame;  
Some made crystals showed, on analysis,  
Carbon combined in the crystallized form,  
Thus diamond, indirectly, was art-form'd.  
Boric Acid, when fused, is clear like Glass,  
And dissolves metallic Oxides with ease.  
Boron is never found in native state,  
But occurs combined in small quantities,  
One form being the Boron Trioxide.  
Min'ral **Boracite** is Magnesium Borate.  
**Tincal**, a crude Sodium Biborate,  
Is found native in some Persian waters;  
Purified, it is called **Borax**. In Tuscany  
Borax is made from native Boric Acid  
As found in solution in the water  
Contained in late form'd Volcanic lagoons;  
In Peru it is made from **Hayesine**  
(Calcium Borate) a natural product.

Boron is prepared by heating, in Iron vessel,  
 Fluoride of Potassium and Boron,  
 (A double Salt) with metallic Potassium ;  
 The product is then well wash'd with water,  
 To free it from all soluble matter.

**Artificial gems** are made from Oxides  
 Of different metals, fused with Boric Acid.  
 Borax is much used for fine metal fluxing,  
 It's also employed in fine-metal soldering.

#### ATYAN.

**CARBON**, combined, forming Life's chief tenement,  
 An abundant, allotropic metalloid ;  
 Is found in nature pure and crystallized  
 In two distinct and very different forms ;  
 Transparent—as **Diamond**, Opaque—as **Graphite**  
 (**Plumbago**), and, in an Amorphous state  
 (Non-crystallized) briefly—as **Min'ral Charcoal**.  
 Carbon is Life's choice structural element  
 In the vegetable and animal worlds ;  
 And in **Peat, Coal-Beds, Anthracite**, and **Shale**.  
 Crystallized Carbon—as **Diamond**, a gem  
 So greatly prized, in perfect purity



Is colourless, and of high refractive power ;

Diamonds are found of various hues

Snow-white (known as the "first water"), rose-red,

Prussian blue, yellow, brown, and also black.

The Diamond is the hardest substance known, its crystals

Are octohedral, and are found detached,

Embedded in **gravel** or **drift material**,

Through Brazil, Borneo, India, and Cape.

A very intense heat, with Air excluded,

Converts the Diamond to a piece of Coke ;

Burnt in Air, it forms Carbon Mon-and Di-oxide.

**Graphite**, the trail substance in "lead pencils,"

Frequently call'd **Plumbago** or **Black Lead**,

Is pure Carbon often mingled with Iron ;

Sometimes, but rarely, it occurs in crystals.

Graphite is found in Borrowdale, Cumberland,

Also in Nova Zembla and Ceylon.

**Ironfounder's "Kish,"** the scum on molten Iron,

And seen through cold Pig-Iron, is Art-form'd Graphite.

Oils, Greases, or Resins, burnt in vessels,

To which Air is partially admitted,

Deposit "**Lamp Black**," (**Soot**, impure **Amorphous Char**)



'Tis also obtained, in earthy impure state,  
By imperfect combustion of Pit-coal,  
Or Slack (the "smalls" of coal); or distilling Cannel,  
Shale, or Coal, at Gas or Paraffin Oil Works.  
These processes yield different qualities  
Of **hard** and **soft** Coke. Each has a special use.  
**Coal** and the **Shales** are min'ralized Carbon,  
The residue from once vegetation,  
Consisting of Forests, Underwood, and Moss,  
Fallen into decay and overlaid with earth:  
They contain Carbon, Hydrogen, Oxygen,  
And Nitrogen, variously combined;  
Besides these, they hold consequent Min'ral Salts.  
Amorphous Char of greater purity,  
Is obtained when distilling **Wood**, or **Sawdust**,  
By Pyroligneous Acid makers;  
When distilling **Peat** for Oily products,  
Or burning it with a brief amount of Air.  
Hard-wood Char absorbs gases in its pores;  
Of Ammonia Gas, ninety times its bulk,  
Though of Hydrogen, only twice its bulk:  
This Char, and those from Peat and Bone, absorb Air;



Causing death, to persons sleeping in ill vent Rooms  
Where charcoal stoves are used, and, to sleepers by limekilns.  
Carbon Dioxide, so frequently named  
Carbonic Acid, is a colourless gas,  
Having an agreeable pungent taste  
Sweetly proved in effervescent Wines and Waters,  
In which it is largely dissolved by pressure ;  
If inhaled *per se* for few minutes it causes death .  
This narcotic pois'nous compound is form'd  
When burning Char in Air or Oxygen ;  
And is found in Smoke from burning Coal; exhaled **Breath**;  
And decomposing **effloral matter**;  
It is produced in nearly all **fermentation** ;  
It exists in "**after damp**" of Coal Mines,  
As well as in **gas emissions** from **Volcanoes**.  
Carbon Dioxide is found in many **Spring Waters** ;  
If Lime be present, such waters petrify  
Birds' nests, Plants, or Ornaments, when immersed.  
In trace it's of vital need in our Atmosphere.  
Carbon Dioxide is promptly obtained from **Marble**,  
By treating with Acid and collecting gas,  
Through displacement of Air, in a glass vessel.

This gas, though produced during combustion,  
Is *per se*, the extinguisher to combustion  
Of common things. Some Metals decompose it.  
Water dissolves its equal bulk of this gas.  
The gas, compressed to clear liquid, will mix  
With Alcohol and Hydrocarbon Oils :  
Congealed by great cold, it appears like Ice ;  
It can also be form'd in white snow-like flakes ;  
Those flakes, if pressed by hand, blister like a scald.  
Its nature - use is to supply plants with Carbon ;  
In presence of Light, green leaves absorb it,  
Retain the Carbon, and exhale the Oxygen ;  
Of the precise mode, we yet are ignorant.  
In nature's **two divisions**, the Carbonates  
(Carbon Dioxide Salts) are numerous ;  
In Floral nature, with Calcium and Magnesium,  
Existing in **masses like mountain ranges**,  
As form'd by Coral insect the busy Sea-bee.  
It's also found combined with other metals ;  
In effloral bodies,—in **land-plants**, it's combined  
With Potassium ; in **sea-plants**, with Sodium.  
The compounds of Carbon with Hydrogen

Belong rightly to Effloral Chemistry :

They form a numerous class of substances.

**Light Carburetted Hydrogen (Methane, Marsh Gas, Fire Damp)** is alas ! too often emitted

From Coal, both in Mines and after it is cut :

Mix'd with Air, and brought in contact with Flame

It has caused disastrous explosions in ships.

The same gas is found in mud of old ponds.

It is combustibile but not pois'nous,

It goes with Chlorine in light but not in the dark.

**Heavy Carburetted Hydrogen (Ethene, Olefiant Gas)** smells much like garlic,

It burns with a very brilliant white light.

Coal, Cannel, Shale, or Wood, exposed in retorts

To red heat (destructive distillation),

Yield many Carbon-Hydrogen gases

Possessing high illuminating power ;

Together with Nitrogen, Hydrogen,

And Sulphur compounds, consider'd impurities :

The liquid products are **Ammonia-liquor** and **Tar**.

From Tar, **Benzol**, and **Aniline** are form'd

Which yield our grandest colouring bodies :—

As **Magenta**, **Roseine**, **Solferino**,  
**Mauve**, **Purple**, and magnificent **Blue** dyes.  
Distill'd Tar gives **Naphtha**, **Naphthaline**, and **Pitch**.  
Carbon associates with Nitrogen  
Forming a compound call'd **Cyanogen**;  
This, combined with metals, forms **Cyanides**;  
If allied with Hydrogen, **Prussic Acid**  
(**Hydrocyanic Acid**) is form'd;  
A volatile liquid that boils at summer heat;  
It's an instant poison oft used by suicides,  
One drop! and even vapour! causing death.  
This compound can be made from Bitter Almonds,  
The Kernels of Plums, Peaches, Apple seeds,  
And leaves of Cherry Laurel, by distillation;  
It exists ready form'd in juice of Cassava.  
The presence of this poison after death,  
Can be detected with profound certainty.  
**Ferro-Cyanide of Potassium**,  
Or **Yellow Prussiate of Potash** is form'd  
By fusing dry refuse animal matter,  
As parings of Hoofs, Horns, or Hide cuttings,  
At a red heat, with impure Potassium Hydrate



And Iron filings, placed in closed vessel ;  
The mass is afterwards boiled in water,  
The solution boil'd down, and Salt crystallized :  
The liquor, with Ferrous Sulphate solution  
And dilute Nitric Acid, forms **Prussian Blue**,  
A Printer's and Dyer's beautiful blue pigment,  
In appearance resembling Indigo.  
Animal and vegetable compounds,  
When distill'd in close vessels, yield **Carbon**,  
(**Charcoal, Coke, Char, or Amorphous Carbon**) ;  
Charcoal thus prepared will retain Oxygen  
And Hydrogen with great affinity.  
It requires high heat to drive out their last trace.  
The presence of different Mineral Salts  
Produces the varieties of Char.  
The **Diamond** is almost pure Carbon.  
Commercially pure Carbon is obtained  
When distilling Shale or Petroleum Oil,  
In Iron Stills, and exposing the Still Coke  
Produced, to red heat in Fireclay Retorts ;  
Such Carbon, ground, (\*S. P. Moulder's Blacking)

\*Vide author's published British and Foreign Patents. British No. 2479—1866.

Is greatly esteemed by Ironfounders  
 For “facing” sand mouldings prior to filling  
 With melted Iron ; it “smooth-skins” the metal.  
 Diamonds are used by Glaziers to cut glass.  
**Diamond-dust** is used to polish the gem.  
 Char from soft wood is used as furnace fuel ;  
 That from hard wood, chiefly for Gunpowder.  
**Ceylon Graphite** is used for Lead pencils,  
 And for making Plumbago crucibles  
 Such as are used by Steel, and Brass, Founders. Plumbago  
 Is also employed for polishing Iron ;  
 Ground fine, and compressed, it forms **House Blacklead**.  
 Charcoal being insoluble in Water,  
 Wood stakes are often charred to preserve them :  
 Casks charr’d, keep Water fresh for a long time  
 By preventing its action on the staves.  
 Charcoal finely divided,—as Lamp Black,  
 Or Ivory Black,—is used for Paint and Printer’s Ink.  
 \*2 **Peat Char** is made with great simplicity  
 From part-dried Peat, which need not be trucked until charr’d,

Vide author’s published British and Foreign Patents.

\*2 British No. 2500—1871.

American Patent—No. 133,894—1872.



By limited combustion in Iron Drums ;  
 The fire from one working drum, or cylinder  
 Can start a thousand peat-charged drums on open Moss.  
 \*3 **Modified Peat Charcoal** makes excellent "Gas Fuel"  
 For Gas Works situate near the Sea-coast,  
 And also Ironfounders' Blacking (Moulder's Carbon);  
 \*4 Compressed into tongued and grooved bricks it forms Fuel;  
**Brick-Fuel**, so moulded, packs well for transit  
 As it occupies the least space for stowage.  
 Such form'd bricks, moulded or cut from hard stuff,  
 Would form portable sheds, or, compact mass.  
 The Char is good for metallurgical purposes,  
 And for general use in some Furnaces.

## BAGEN.

**NITROGEN**, Moderator to Queen Oxygen,  
 Is a colourless gaseous metalloid,  
 Lighter than Air, and without odour or taste.  
 It is uninflamable, and therefore  
*Per se* extinguishes combustion and life.  
 Its presence in Air is wisely ordained

Vide author's published British and Foreign Patents.

\*3 British No. 989—1872.

French and Belgian Patents ———

\*4 „ „ 100—1872.

To dilute the Oxygen with which it's found  
In a diffused but not in a combined state.  
Pure Nitrogen stifles all Animal  
And Fuel combustion, yet it is not pois'nous.  
Nitrogen unites freely with Oxygen  
In true mathematical ratio,  
Forming the Nitrogen Mon, Di, Tri, Tetr,  
And Pent, Oxides respectively. The Tri-  
And Pent-Oxides form Nitrites and Nitrates,  
Their water compounds (Salts of Hydrogen),  
Being call'd Nitrous and Nitric Acids.  
Nitrogen Monoxide (**Nitrous Oxide,**  
**Laughing Gas**) is a colourless sweet tasted gas,  
Almost inodorous; in small quantity  
Given under advice it is safe to inhale,  
The result being insensibility  
To pain, with sometimes strange hallucinations.  
This gas, condensed to liquid state by pressure  
And placed in vacuo, evaporates  
So suddenly, as to produce the **most**  
**Intense cold** known—minus one-hundred and forty:  
Some Red hot bodies plunged in this gas, will burn

More brightly than in ordinary Air  
Owing to its elements being loosely combined :  
It is produced from Ammonium Nitrate  
By placing in Still heated by Spirit-lamp :  
Dentists use this gas, naming it **Pain Killer**.  
Nitrogen Dioxide (Nitric Oxide)  
Is a colourless gas which, with Oxygen,  
Produces deep red fumes that water will absorb.  
Nitrogen Trioxide, when by cold condensed,  
Is a blue liquid with orange-red fumes.  
Nitrogen Tetroxide (also known as  
Hyponitric Acid), condenses by cold  
From gas to transparent prismatic crystals.  
Nitrogen Pentoxide (Nitric Oxide,  
Anhydrous Nitric Acid, Nitric Anhydride)  
Exists in six-sided prismatic crystals  
Colourless and very apt to explode ;  
It combines with Water, yielding great heat,  
And forming the compound Hydrogen Nitrate.  
It is found combined in large quantities,  
Efflorescing on Animal-polluted soil  
In hot dry climates like that of India

As Potassium Nitrate (**Saltpetre**,  
**Nitre**), and Sodium Nitrate (**Chile**  
**Saltpetre**, **Cubic Nitre**). Nitric Acid, pure,  
Is a colourless liquid. The common Acid  
Has golden yellow hue, due to Oxides  
Of Nitrogen in solution. It stains  
The skin yellow, finally destroying:  
Pour'd in warm Oil of Turpentine it fires,  
And on red hot Charcoal it burns splendidly.  
The strong acid acts reluctantly on metals  
But when it is diluted with Water,  
It will speedily form combinations.  
All Nitrate Salts will dissolve in Water.  
**Nitric Acid** of commerce (**Aqua Fortis**),  
Is chiefly made from Sodium Nitrate  
Which, first placed in Cast Iron cylinders, Acid  
Sulphuric in *quantum sufficit* is poured in,  
The whole is then heated, and the fumes condensed  
In receivers made of Glass or Earthenware ;  
From these it is run into basketed Carboys.  
Direct Sun-light de-oxides Nitric Acid.  
Nitric Acid is form'd in rotted manure ;

In trace through moist Air by Electricity ;  
In nature at time of a thunderstorm,  
And, by experiment, with a Battery ;  
Also, by oxidizing Ammonia.

**Ammonium**, a counterfeit metal,  
Is Nitrogen with Hydrogen combined  
In proportion of one to four. In lustre  
And action it's very like a metal.  
It forms a weak amalgam with Mercury,  
And will combine with some other Elements.  
Its Salts closely resemble fix'd Alkalies  
(Potassium and Sodium compounds).

Ammonium exists only under great pressure  
With low temp'rature : if to Air exposed,

**Ammonia** ( A m m o n i u m O x i d e )

Is form'd, a very volatile compound.

Ammonium Sulphate occurs in certain **Springs**,  
**Tuscan** earths, and in **Volcanic** lavas ;

It is Art-formed from Ammonia Liquor.

Ammonia exists in trace in **Air**,  
Forming the medium from which Plants absorb  
Nitrogen to construct their Seeds and Fruit.

Ammonia, and Ammon-Carbonate, are produced  
 From the distillate obtained when distilling Bones  
 For Animal Charcoal, or when charring  
 Any kind of waste Animal matter ;  
 The **Smoke** from ignited Peat and from Coal  
 Contains Ammonia ; as does also stale **Urine**.  
 The **Ammonia Liquor** from our Gas Works  
 Is a most abundant source for the Salts :  
 Neutralized with Hydrochloric Acid,  
**Sal-Ammoniac** (A m m o n - C h l o r i d e ) is form'd :  
 The liquid is evaporated to dryness  
 And the Salt heated to destroy the Tar,  
 'Tis then sublimed in vessels having Lead Domes.  
 In old times 'twas prepared from Soot of Camels' Dung.  
 Ammonium Sulphate is used to make Alum  
 And to compose most Artificial Manures.  
 A m m o n - C a r b o n a t e (**Sal Volatile**),  
 Occurs native though impure in **Guano** ;  
 It is much used by metal solderers,  
 To cleanse the surface of metals from grease ;  
 And, by Printers and Dyers, to brighten colours.  
 Concentrated Ammonia solution



Is used for making Ice artificially ;  
In one of two strong Air-tight connected drums,  
Arranged like a Still with large condenser,  
The Ammonia liquor is placed and warm'd ;  
The other drum is fix'd in cold water ;  
The Ammonia, freed by heat in one drum,  
Condenses by its own gathered pressure  
In the other ; the fire being then removed,  
The Ammonia is reabsorbed by the Water  
In the first drum ; much heat is thus latented,  
Bringing the measured water, outside condenser,  
To a state of congelation—block Ice.  
Ammonium Sulphide (Ammonium Sulph.Hydrate),  
Often given off from decomposing  
Animal and vegetable matter,  
Is made direct from Ammonia solution  
By saturation with Hydrogen Sulphide ;  
Ammonium Sulphide is largely used  
In Laboratory as a metal test.  
Nitrogen forms a series of compounds,  
With compositions much like Ammonia,  
As **Hydroxylamine** and other —amines.

Nitrogen unites sometimes with metals,  
If Ammonia be passed over heated  
Copper- or Chromium- Oxide, Nitrogen  
Is absorbed, though at red heat it will again evolve  
And leave a residue of reduced metal.  
Nitrogen forms about four fifths, by measure,  
Of Air, and is, by weight, near three and a quarter times  
Heavier than the weight of Oxygen in Air.  
The composition of our Atmosphere,  
Weight for weight, is uniform at every height.  
Nitrogen exists in combination  
In Animal and Vegetable bodies.  
Nitrogen is sometimes prepared from Air,  
By extracting the mingled Oxygen,  
As by burning Phosphorus in a Bell-glass ;  
Another method is to pass stream of Air  
Through red-hot Porcelain tube fill'd with Copper  
Turnings, or newly made Spongy-Copper.  
Nitrogen is also freed when Ammonia  
In solution, is aerated with Chlorine ;  
This process must be stopped before making  
The liquid neutral, or it may explode !



Through presence of Chloride of Nitrogen.

A good and safe plan to prepare Nitrogen,

Is to boil Potassium Nitrite solution

With Sal-ammoniac, the pure gas is then freed.

Nitrogen is as essential to Man,

And animals, as Oxygen and Carbon.

Nitric Acid is extensively employed,

In dissolving Tin, and Iron, for mordants

Used by Dyers and Calico Printers ;

For etching on Printers' Steel and Copper rollers ;

'Tis used in Medicine ; fine Metal Assaying ;

For experiments in Laboratories ;

And in working some Electric Batteries.

#### BEGEN.

**OXYGEN**, the Queen of Body Affection ;

The supporter of man's Earthual life ;

The needed Air-puff for all common forms

Of combustion in term'd live Animals,

In ordinary burning Wood or Coal ;

And the prime mover in most heat-felt goceptions,

Is a colourless gaseous metalloid,

Tasteless and devoid of odour. Pressure,

To the fullest extent of known power,  
And the most intense cold, fail to make it liquid.  
Oxygen is somewhat heavier than Air ;  
It oxides all Elements except Fluorine.  
Oxygen, singly, is the most active  
Producer of Combustion, Heat, and Light, known.  
When Carbon bodies—as Wood, Match, or Taper,  
Are lighted, then blown out, and, whilst red-hot,  
Promptly dipp'd in bell-glass of Oxygen,  
They re-kindle and burn with great brilliancy !  
A Steel Watch-spring, or Iron Wire, made red hot  
And plunged in the gas, scintillates splendidly !  
Sticks of lighted Phosphorus, or Sulphur,  
Burn in Oxygen with **dazzling glory** !  
The effect is to oxide these bodies  
More quickly than in ordinary Air ;  
The heat and light are thus evolved fiercely  
Through rapid union of the Elements,—  
Oxygen, with Carbon, Iron, Phosphorus,  
Or Sulphur. A similar combustion,  
But less energetic, accompanies **Life**.  
The breathing process in all Animals,

Though to less degree, causes combustive warmth  
Due to colliding chemical union.

**Blood** contains compounds which, on exposure  
At lungs to Air, take up Oxygen, afterwards  
In circulation, chiefly in the capillaries,  
They combine with it producing animal heat.

Compounds of Oxygen with Elements

Are classed collectively as **Oxides** ;

Those containing the constant proportions

Of one, two, or three, are term'd **Monoxide**,  
**Dioxide**, and **Trioxide** respectively ;

Another, and intermediate compound

Between Mon- and Di-, is **Sesqui-oxide**.

When a metal forms two distinct Oxides,

Its name often ends with **ous** for lower Oxide

And **ic** for higher Oxide ; as Ferrous and Ferric.

**Ozone** is Oxygen in a compressed

Or peculiar allotropic condition,

And may be called **Concentrated Oxygen** :

It has a strange, dry, characteristic smell :

It frees Iodine from Potassium-Iodide

In solution, and is then itself absorbed.

Ozone is faintly soluble in Water,  
Acids, and Alkaline solutions ;  
It is a splendid oxidizing agent ;  
It bleaches and disinfects admirably ;  
It corrodes Caoutchouc, Cork, Vegetables,  
And even rapidly many dry metals ;  
In all such cases Oxygen is absorbed,  
Though the bulk of gas is not diminished,  
Thus proving it to be contracted Oxygen.  
Ozone heated to two-hundred and ninety degrees  
Expands to original Oxygen.  
Paper, moistened with solution of Starch  
And Potassium Iodide, if dipped  
In gas with Ozone in trace, is colour'd blue .  
Ozone is often present in the Air  
Near the Sea in dry and frosty weather.  
Ozone is produced when electric sparks  
Are passed through dry Oxygen, or through Air ;  
Its odour is perceived when working a Batt'ry.  
When Phosphorus is placed in moist Oxygen,  
And left there for some hours, Ozone is form'd.  
It can be prepared by induction ,

By passing Oxygen between Glass tubes  
Coated with Tin-foil and link'd to induction coil ;  
And also when Potassium Permanganate  
Is treated with strong Hydrogen Sulphate.  
Oxygen exists free in our **Atmosphere**,  
Mingled, but not combined, with Nitrogen,  
Compounds of Nitrogen and of Carbon.  
One half the weight of the **Earth's crust** is Oxygen.  
Oxygen exists for the most part combined.  
It forms eight-ninths, by weight, of **Waters of the Earth**.  
As yet we lack a practical method  
For separating Oxygen from Air ;  
It is freed naturally by sunlight ,  
From the **Carbonic Acid** found in Air  
Through medium of substance **Chlorophyl**  
(The green colouring principle of plants) :  
This substance, only when acted on by Sun,  
Takes up Carbon for Plant and frees Oxygen.  
Oxygen is easily freed from some compounds :—  
From red Oxide of Mercury by heating  
In a glass tube, and collecting the gas,  
In inverted jars of water, or gas bags ;

By heating dry Potassium Chlorate  
With or without Black Oxide of Manganese ;  
That Oxide with Potassium Chlorate  
Yields Oxygen at the lowest temp'rature.  
Barium Dioxide heated yields Oxygen.  
Hypochlorite of Lime solution, mix'd  
With Cobalt Oxide, frees pure Oxygen.  
God's grand use for Oxygen, is for life of man.  
Oxygen has been administered,  
With good effect, to diseased humanity,  
In thorax and paralytic complaints.  
Oil of Turpentine, agitated with Air,  
In direct sun-light, forms and absorbs Ozone ;  
Such liquid has double the bleaching power  
Of the ordinary Chloride of Lime.  
It has been employed for bleaching Linen.  
In the Arts, Oxygen, chemically applied,  
Is essential for making bright dyes and colours.  
Ozone is now used for bleaching Sugars.

## BTGEN.

**FLUORINE**, combined, is the caustic for Glass ;  
A metalloid said to be gaseous and colourless,



With keenly susceptible chemical love  
Towards Metals and Metalloid Silicon.  
As yet it combines not with Oxygen,  
Though it will readily with Hydrogen.  
Hydrofluoric Acid (Hydrogen  
Fluoride), is a very volatile gas,  
Colourless, and highly suffocating.  
It is formed when Calcium Fluoride  
(Fluor Spar), ground and treated with Acid  
Sulphuric, is distilled in Lead vessel.  
The Hydrofluoric Acid comes over  
In strong fumes which, when exposed to great cold,  
Liquify; in that state it attacks Water  
With intense energy, forming a hydrate.  
The Water diluted Acid dissolves Glass  
With facility. If concentrated  
And touched by hand, it forms deep sore ulcers.  
Fluorine is not found native, but combined  
With Calcium in Derbyshire Fluor Spar;  
And, with Aluminium and Sodium,  
In Greenland Cryolite. Fluorine trace  
Is found in blood and teeth of Animals.

Fluorine, of uncertain purity,  
Is freed when Hydrofluoric Acid  
Is mixed with aqueous Hypochlorous Acid ;  
Owing to its attacking preparing-vessels,  
Fluorine scarcely can be made in the pure state.  
Hydrofluoric Acid is used to detect  
Presence of Silicon when analyzing,  
And to etch glass—as glass Thermometers ;  
The glass surface, coated with hot bee's wax,  
And design traced out with fine tool, is moistened  
With the water'd Acid ; at other times,  
The clear outlined picture is well exposed  
To vapour of the newly form'd Acid ;  
The Acid, or fumes, will etch glass till neutralized ;  
The object is then clean'd with warm Turpentine.  
Many ornaments are cut from Fluor Spar,  
Such may be seen at nearly every Bazaar.

DAYAN.

**SILICON**, the chief substance in Glass and Pots,  
Call'd **SILICIUM**, is a brown metalloid.  
Silicon exists in three different forms :—  
**Amorphous** ; in **crystals**—like the Diamond ;



And **scales**—like Graphite: the two latter kinds scratch glass.

Silicon Amorphous has no lustre,

Heated in Air it burns till cover'd with Oxide.

It is attacked by Chlorine or Sulphur.

When darken'd by strong heat it becomes denser,

And incombustible e'en in compound flame.

The graphite-form is brighter than Graphite

And infusible. **Silicon Fluoride**

Is a permanent gas; mix'd with water

It yields Silica in gelat'nous form.

Silica when obtained from fine sand fused with Soda,

Is a very fine, white, tasteless powder,

Only slightly soluble in some Acids;

When fused with Alkalies—Potash or Soda—

In large excess, it freely dissolves in Water,

From which Acids throw it down in gelatine form.

With Hydrochloric Acid, and Dialysis,

A peculiar compound of Silica

Is obtained—presumed **Silicic Acid**

In clear, limpid, apt-to-jelly solution.

Silica acts like Acid, forming Salts

With certain basic metallic Oxides;

Many of these Salts are soluble in Water.  
Silicon Hydride (Silicated Hydrogen)  
Is a colourless Gas which fires in Air  
With a white flame, forming clouds of Silica.  
Silicon Tetrachloride is a liquid,  
Very volatile, colourless, and with pungent  
Suffocating odour; it boils at summer heat.  
**Silica** (the Dioxide) occurs largely  
**In flints**, and the **rocks** forming the Earth's crust;  
'Tis most abundant in the primary Rocks;  
It will not vapour at any known heat.  
The colourless, transparent **Rock Crystal**  
Is nearly pure Silica. **Agate, Quartz,**  
**Flint**, and **Chalcedony**, are chiefly Silica;  
Silicon is never found in native state,  
But combined with metals, or as Silica;  
For abundance, it stands next to Oxygen.  
Silicon may be prepared by heating  
Fluoride of Silicon and Potassium  
(A double Salt) in a strong glass tube,  
With an equal weight of Potassium;  
After violent action Silicon is freed

In amorphous state similar to Lampblack ;

It is purified by Water-washing.

The **diamond-form** of Silicon is obtained

By throwing, in a red hot crucible,

Mix'd Potassium Silico-fluoride

Three parts, Sodium one, and Zinc one part ;

These when fused at melting point of Cast Iron, and cool'd,

Yield Silicon in form of octohedral crytals.

Hydrofluosilicic Acid is used

As test for Potassium and Barium,

With which it forms insoluble precipitates.

In the manufacture of Porcelain,

Finely ground Silica is of great value.

**Crown Glass, Plate, and Window Glass**, are composed

Of Silicates of Sodium and Calcium,

A compound that melts at low temp'rature.

**Bohemian Glass** contains a compound

Of Silicates of Potassium and Calcium ;

This requires a high temp'rature to fuse.

**Crystal, or Flint Glass** is always composed

Of Silicates of Potassium and Lead ;

The Lead, added as Red Lead, densifies

The Glass, making it lustrous and more fusible.  
Common green **Bottle Glass** contains Scrap Glass,  
And a rough compound of the Sodium,  
Calcium, Aluminium, and Iron Silicates.  
Quartz Sand, or pure Sand, preferr'd fine and white,  
Is the source for the Silica; Pearl Ash,  
Soda Ash, and Salt Cakes, for their metals;  
And Chalk or Lime for the Calcium metal:  
The substances are brought to fusion heat  
In large fire-clay crucibles. Broken Glass  
Of each kind is call'd **Cullet**. It is re-melted.  
Whilst Glass is being made in the crucible,  
The Oxygen in the crude materials  
Combines with organic matter chance present,  
Thus both are expelled as Carbon Mon- and Di- Oxides.  
The methods of "casting" and "blowing" glass  
Are most interesting and should be seen.  
The glass articles when formed are annealed  
In special oven by slow cooling down,  
This prevents irregular contraction of parts.  
The Oxides used to colour glass are named  
In the Verse to respective elements.

In Bottle Glass, to make it colourless,  
Manganese Dioxide is often added  
To oxide the green Ferrous Silicate,  
It thus nullifies objectionable colour.  
Arsenic Trioxide has a like effect.  
Artificial Gems are based with Lead Glass  
Call'd Paste, made richly brilliant by much Lead.  
Soluble Potassium Silicate  
(Soluble Glass) is used to preserve Stone  
From decay; to make Artificial Stone,  
And for mural painting call'd Stereochromy.  
The soluble Sodium Silicate  
Is largely used by Soap makers, in Soap,  
For its cleansing, hard'ning, and water-scope.

## DEYAN.

**PHOSPHORUS**, tonic element in Brains,  
Is a yellow hued wax-like Metalloid,  
Soft and flexible at common temp'rature,  
Semi-transparent, and exceedingly  
Inflammable. It is insoluble  
In, and should be preserved under, Water;  
It melts in warm water, and at low heat boils;

With slow cooling, it forms dodecahedrons.  
It is eas'ly inflamed on exposure  
To Air at common heat, and quickly, with a blow  
Or hard rub. It should be handled with care.  
Exposed to Air it is dimly luminous  
Yielding whitish smoke due to slow combustion  
With Oxygen of Air, an effect, strangely,  
Prevented by the presence of Vapour  
Of Ether, Oils, or Oil of Turpentine ;  
In their vapour it can even be distilled.  
Phosphorus acts strangely with Oxygen ;  
With pure Oxygen, at low heat, it will not unite,  
But if warm'd, or is impure, it oxides at once,  
Inflaming with transcendant glory .  
Phosphorus is soluble in most Oils,  
Naphtha, and largely in Carbon Bisulphide.  
By heating ordinary Phosphorus  
In atmosphere of Carbon Dioxide,  
To heat of two hundred and fifty degrees  
For fifty hours, it becomes **Amorphous** ;  
It is then much denser, infusible,  
Difficultly luminous, and, in Oils,

Insoluble : its colour is red-brown.

If now heated to two hundred and sixty

It is rechanged to common Phosphorus !

Phosphorus combines with Oxygen,

Forming a Trioxide, a Pentoxide,

Or a Hypophosphorous Acid.

Phosphorus Pentoxide, obtained when burning

Phosphorus in dry air under Bell Glass,

Is a snow-like body, with powerful

Affinity for water ; thrown in that liquid

It combines with explosive violence ;

From water it cannot again be separated ;

Such compound heated to redness becomes “glacial.”

Phosphorus combines with Hydrogen

Forming Phosphorus Trihydride, a gas

Analogous in some cases to weak

Ammonia ; it has a strong smell like Garlic ;

This Trihydride (Phosphoretted Hydrogen)

Has a most remarkable property

Of bursting into flame spontaneously

When in contact with Air, or Oxygen Gas ;

It's a splendid though hazardous experiment.



It is very unstable, and, in glass jars,  
Is decomposed by exposure to light.  
Phosphorus, when placed in measured Chlorine,  
Will form a Tri- or a Penta- Chloride  
By gently heating in the well dried Gas.  
Its Oxy- and Sulpho- Chlorides can be form'd;  
And also —**I**des with Bromine and Iodine.  
Phosphorus melted with Sulphur in Water  
Will, even then, combine with combustion  
And, sometimes, with violent explosion.  
The Body-phosphates, chiefly Calcium Phosphate,  
Found in the **B**ones of Man and Animals,  
Impart tonic stiffness and rigidity  
To the skeleton structure. They also  
Form a needful Salt in the **B**rain and **N**erves.  
Phosphorus always occurs in combined state,  
With Oxygen and other elements,  
In the primitive unstratified **r**ocks,  
And in the **l**avas of modern origin:  
When those rocks disintegrate down to soil,  
Plants absorb a portion of the Phosphates  
Which, Animals eating, they in turn absorb,



And hence such Salts are found in **Bones** and **Urine**.  
Phosphorus is found in minerals **Apatite**  
(**Calcium Phosphate**) and **Phosphorite**.  
Phosphorus is obtained from ground calcined Bones,  
By treating with cold dilute Sulphuric Acid,  
The liquid is boiled down to a syrup  
(Super-Phosphate of Lime in solution),  
Then mix'd with fine Char, and throughly dessicated  
In an Iron vessel exposed to high heat ;  
When dry, it's transferred to Stoneware Retorts,  
The necks of which are placed under Water ;  
When heated to redness, the Phosphorus  
In part distils, condensing in yellow drops :  
(The Coke contains Calcium Pyrophosphate).  
The metalloid is purified by redistilling,  
And moulding, under Water, into Sticks.  
The **Phosphorescence** of Sea Animalculæ,  
Light decaying Wood, the American Firefly,  
British Electric Centipede, Glow-worm,  
Putrefying Fish, and Flesh of Mammalia,  
With that found in some minerals, is supposed  
Due to Phosphorus in loose combination,

With and without brief sunlight absorption.

Phosphorus is made very extensively

For the production of cheap Matches and Fusees ;

The fumes in the process give rise to sad disease.

• DTYAN.

**SULPHUR**, in fumes, the typical Air of Hell,

Call'd BRIMSTONE, a yellow solid Metalloid,

Is very brittle. If heated in Glass retort

Out of contact with Air, it distils unaltered.

It's a non-conductor of Electricity,

But is speedily made electric by friction.

Sulphur can assume, amongst other forms,

These allotropic conditions, **Plastic**,

**Powdery**, **Octohedral**, and **Prismatic** ;

The crystalline are the chief varieties.

Its specific gravity varies

According to the form of its Crystals.

Sulphur melts at one hundred and twelve degrees ;

At a higher heat, and pour'd in Water,

It temporarily assumes an elastic form

(A flexible amorphous condition).

The prismatic crystals, are well obtained

By the slow cooling of melted Sulphur.  
The octohedral, is its form in nature.  
Sulphur is freely soluble in Carbon-  
Bisulphide ; slightly in Oil of Turpentine,  
And Fat Oils ; but, i n s o l u b l e in Water.  
Sulphur, in some chemical relations,  
Bears a strong resemblance to Oxygen ;  
Many Sulphides correspond to Oxides,  
Some of them form Salts resembling Oxy-salts.  
Sulphur warm'd with Fats is altered in colour.  
A blue substance is obtained by mixing  
Ferric Chloride and Hydrogen Sulphide solutions ;  
It is a peculiar form of Sulphur.  
Sulphur unites freely with Oxygen.  
Sulphur Dioxide forms Hydrogen Sulphite  
With water, or true Sulphurous Acid ;  
Sulphur Trioxide forms Hydrogen Sulphate  
With water, commonly termed Sulphuric Acid.  
There is a Hyposulphurous Acid  
And a series call'd Polythionic Acids.  
Sulphur Dioxide ( Sulphurous Oxide ),  
Form'd by burning roll-Sulphur in dry Air,

Is a colourless gas with the strong odour,  
Suffocating, life and flame extinguishing,  
Character of burning Brimstone ; it is soluble  
In Water, then forming Sulphurous Acid  
Which, on exposure to Air or Oxygen,  
Through time is slowly changed to Sulphuric Acid.  
Sulphurous Acid is a Bleaching agent,  
It acts as a de-oxider to colours;  
It frees Hydrogen, joins with Oxygen,  
And thus forms dilute Sulphuric Acid.  
Chlorine acts the reverse ; both need Water.  
Sulphur Trioxide (Sulphuric Oxide)  
Is a beautiful crystalline white silky mass,  
Much similar to fine white Asbestos ;  
Thrown in water, it hisses like red hot Iron :  
It's prepared by distilling Nordhausen  
Sulphuric Acid with Phosphoric Oxide.  
**Nordhausen Sulphuric Acid** is made  
By distilling the dried Ferrous Sulphate,  
Obtained from Air-oxidized Iron Pyrites  
At a red heat in Earthenware Retorts ;  
The product is a strong fuming Acid.

**Sulphuric Acid (Hydrogen Sulphate, Oil of Vitriol)**, when pure, is a colourless Oily liquid. It will char organic matter And distil without decomposition. It's made by bringing Sulphurous Oxide, Nitrogen Tetroxide, and Water, together : Native Sulphur is burn'd in small furnace With a wide flue, leading into one of two Sheet Lead Chambers, as seen at many Works In Chemical facturing districts:—Inspect ; The flame from the Sulphur is made to heat A crucible containing mix'd Nitre And Oil of Vitriol, this gives off vapour Which, with Air and jet of Steam, is led to Chamber, The floor of which is covered with Water ; Here the gases act upon each other, Sulphuric Acid is form'd, and absorbed By the Water until mod'rately strong : An exit pipe, at the end of far chamber, Permits the spent waste gases to escape. The Acid Water is drawn off and boil'd down, First in Lead pans—forming “**Brown Oil of Vitriol**”—

Then 'tis concentrated in Platinum Stills,  
Whence it is pour'd into basket-cased Carboys.  
The Commercial Acid contains impur'ties  
Chiefly Nitric Acid, Lead, and Ars'nic.  
Oil of Vitriol is also largely made  
By burning Iron Pyrites, Copper Pyrites,  
Or Blende, in place of Sicilian Sulphur.  
Sulphuric Acid vapour, passed over  
Red hot Platinum, yields free Oxygen,  
And Sulphurous Acid which water separates.  
Hydrogen Sulphide is a colourless gas,  
When pure with faint repulsive smell; inhaled in trace,  
It has strong tendency to produce sleep;  
Set on fire in Air it burns with blue flame;  
It forms black, yellow, brown, and red compounds  
With metals—as Vermillion, and Mosaic Gold:  
It's prepared by treating Iron Monosulphide,  
In flask, with dilute Sulphuric Acid.  
Hydrogen Disulphide is very unstable.  
The great compound of Sulphur with Carbon  
Is **Carbon Bisulphide**, a colourless  
And exceedingly volatile liquid;

'Tis heavier than Water, with high refractive,  
Dispersive, and penetrating power.  
When impure it has very strong disgusting odour,  
And is pois'nous if largely inhaled or drunk ;  
It's highly inflammable, burning with blue flame :  
With Oxygen, it forms an explosive gas ;  
It dissolves Sulphur (the liquor yields splendid crystals),  
Oils, and Greases, freely ; also Camphor,  
Iodine, Phosphorus, and Caoutchouc.  
Carbon Bisulphide, as commercial product,  
Is made in tubulated Clay Retorts ;  
They are fill'd with Char and heated to bright redness,  
Then Sulphur is dropp'd in through Porcelain tubulus ;  
The resulting vapour is led to Condenser,  
Through Iron or Lead pipe in tank cool'd by Water.  
Sulphur with Chlorine makes unstable compounds.  
A Sulphur Iodide is of vermillion hue.  
Sulphur is often found in the free state,  
In proximity to Gypsum, and Salt-beds ;  
And occurs as Sulphuretted Hydrogen  
(Hydrogen Sulphide) in certain min'ral waters,  
And decaying organic matter.



An Oxygen compound (Sulphur Dioxide)  
Is largely emitted from **Volcanoes**.  
Native Sulphur is imported from Sicily.  
Sulphur also occurs, widely diffused,  
With **metals**—as Sulphides, and, plus Oxygen,  
As Sulphates. Iron and Copper Pyrites  
Are Sulphides, Galena is Lead Sulphide,  
Blende is Zinc Sulphide. There are many other Sulphides.  
Of Sulphates, there are Gypsum (Calcium  
Sulphate), Barytes (Barium Sulphate),  
And, in trace, Sulphates of other Elements.  
Sulphur of commerce is roughly prepared  
By distilling native earthy Sulphur,  
Placed in Clay vessels, within a brick furnace;  
The vapour, kept from Air, is sublimed in pots;  
Re-melted and moulded it makes "**Roll Sulphur**."  
When Roll Sulphur is suddenly heated  
It crumbles, splitting up with a crackling noise.  
"**Flowers of Sulphur**" is form'd by sudden cooling  
Of Sulphur vapour in spacious chambers;  
It falls, snow-like, in crystalline powder.  
Sulphurous Acid is used in the Arts



For bleaching Straw-plait, Woollen, and Silk goods.

Nordhausen Sulphuric Acid is used

For its effect of dissolving Indigo.

Sulphuric Acid is used enormously

For making Soda Ash, and Metallic Salts,

As employed by Soap Makers, Printers, and Dyers;

It's also used, though slightly, in Medicine;

And, with Nitric Acid, in electric Batt'ries.

Sodium Hyposulphite is greatly used

In Photography, to dissolve out Silver Chloride

Which has not been blacken'd by Light; it thus "fixes"

The picture by preventing Light's further action.

It is also used as an Antichlor,

To remove last trace of Chlorine from Bleached Goods;

And from the Rags used to produce Paper.

Carbon Bisulphide is used extensively

To extract Oil from Paraffin "Press-bags,"

Cotton-waste, and Seeds; also for Bitumen

From Minerals. 'Tis used in vulcanizing Caoutchouc;

And in the preparation of Gutta Percha.

Sulphur is often employed medically,

Both *per se* and combined with Iodine,

The latter is good for skin diseases.

Sulphur when brought into a melted state,

Is used to make Matches of second rate.

#### EBGEN.

**CHLORINE**, an obedient Spirit of the Sea,

Is a yellowish-green gaseous Metalloid,

Of most powerful suffocating odour

Sorely irritating to the eyes and lungs ;

When very faint, it smells like stale seaweed :

It's soluble in Water, but, in that liquid,

By exposure to **Sunlight**, 'tis slowly changed

To Hydrochloric Acid and free Oxygen.

Inhaled in quantum, Chlorine is pois'nous.

A lighted taper will burn in Chlorine,

Forming Hydrochloric Acid and free Carbon.

Paper moist'ned with Oil of Turpentine,

And plunged in Chlorine, will burst into flame.

Phosphorus, Copper leaf, powdered Ars'nic,

And other bodies, ignite in Chlorine.

Equal quantums of Chlorine and Hydrogen,

Mix'd together, combine slowly in dull light,

But with explosion when exposed to sun's rays.

Chlorine Water has strong bleaching powers,  
It will decompose all organic colours,  
But will not bleach in absence of Water.

Chlorine has great natural resemblance  
To Iodine, Bromine, and Fluorine ;

It has great attraction for most metals,  
And Hydrogen, but not much for Oxygen.

Hydrochloric Acid is a colourless gas  
Which fumes strongly in Air, from condensing  
The moisture usually contained in Air ;

While condensing, much heat is given out.

In the production of Sodium Salts,  
This Acid is made as a bye product :

Iron Cylinders, Lead vessels, and Carboys  
Are used when making it on the large scale.

The commercial Acid is very impure.

“**Aqua Regia**” is mix'd Hydrochloric  
And Nitric Acids ; a potent mixture

For dissolving metals, though 'tis Chlorine  
Only that attacks and combines with them.

Chlorine forms four Oxy-acids with Oxygen  
Plus Hydrogen, namely—Hypochlorous,

Chlorous, Chloric, and Perchloric Acids;

These compounds, though each very unstable,

Are powerful bleachers and oxidizing agents:

Some will explode with but slight provocation.

A mixture of Potassium Chlorate

And Sugar, damp'd with Sulphuric Acid,

Is almost instantly set on fire.

Chloric Acid will set fire to Paper.

Perchloric Acid will explode with Ether,

Or Charcoal, with tremendous violence.

Chlorine forms sev'ral compounds with Carbon.

Nitrogen Chloride must be made with care,

It is a very volatile liquid,

Exploding at heat of boiling water,

And at common temp'ratures in presence

Of Oils, Fats, or combustible matter:

This substance is **most** fearfully explosive,

'Twill shatter Cast Iron, and deeply indent

Thick Leaden vessels. It is form'd by inverting

A jar of Chlorine in Sal-ammoniac liquor,

It collects and sinks as heavy globules:

Its component parts, being loosely combined,

Will promptly sep'rate with terrific violence.

Chlorine occurs very abundantly

Though always in combined state; with Sodium

And other metals in **Seawater**, and **Min'rals**

With Hydrogen in gas from **Volcanoes**,

But the chief source is **Sodium Chloride**

(**Common Salt**) found in Cheshire and elsewhere.

Chlorine is quickly prepared by pouring

Strong Hydrochloric Acid into glass flask,

Containing ground Manganese Black Oxide,

And heating gently; the gas is evolved

And may be collected by displacement,

Or over warm water; the residue

Contains water and Manganese Chloride.

Commercially, Chlorine is often freed

From mixed Common Salt, Manganese Black Oxide,

And Oil of Vitriol, placed in Lead vessel.

Another process is to pass the Vapour

Of Hydrochloric Acid, mix'd with Air,

Over highly heated Copper Sulphate,

Chlorine with water vapour are thus form'd;

This plan is used for making **Bleaching powder**,

The Copper Sulphate acts continuously.  
Chlorine is largely employed in the Arts;  
As a very potent disinfectant;  
For bleaching Linen and Cotton; also Rags,  
Fibres, Straw, and Grass for Paper Makers.  
For such purposes Chlorine is thus used:—  
Mixed with Steam; as dilute Chlorine Water;  
And largely when combined as Bleaching Powder.  
For disinfecting, Chloride of Lime  
(Bleaching Powder), when dissolved in Water  
And to Air exposed, is slowly decomposed,  
It then absorbs Carbonic Acid from Air  
And evolves Chlorine—the disinfectant;  
Such gas in moist Air, combines with Hydrogen,  
And frees nascent Oxygen, which in turn  
Combines with any putrefactive gas,  
Forming new compounds, free from smell and hue.  
Goods bleached by Chlorine are dipped in Water  
Containing dilute Mineral Acid,  
They are then placed in “whizzers” and washed well,  
The purpose is the Chlorine to expel.

## EMYAN.

**TITANIUM**, the Air absorbing Metalloid,  
 Whose Nitrogen compounds in copper-colour'd cubes,  
 Are found in certain kinds of Iron Slag,  
 In the free state is known only in gray powder,  
 With chemical properties much like Tin.  
 It has power to unite with Nitrogen  
 At high temp'ratures, as in Blast Furnace,  
 There it is found in the residue from Iron Ores;  
 As Titanium Cyanide and Nitride.  
 Titanium is infusible. Titanic  
 Fluoride is a fuming volatile liquid.  
 Titanous Fluoride is a purple powder.  
 Titanium is never found native;  
 Its chief minerals are Rutile, Brookite,  
 And Anatase, diff'rent forms of its Oxide;  
 It's also found in some Iron Ores, Clays, and Silicates.  
 Titanium is obtained by heating Potassium  
 With Titanium-Potassium Fluoride,  
 'Tis then washed, Titanium is the residue.  
 Rutile in Art-formed teeth gives the yellow hue.



## ETYAN.

**VANADIUM**, yielding rainbow hued compounds,  
Is a white solid metalloid, brittle,  
With strong lustre. It is very refractory  
In fire. Powder'd Vanadium thrown into flame,  
Burns with most brilliant scintillations.  
The Dioxide is gray, with metal-like lustre.  
The Trioxide is black, its acid solution, green.  
The Tetroxide is dark blue; in acid  
Solutions in which present, it's of pure blue hue.  
Vanadic Acid in colour is dark red  
To orange-red; with Sulphuric Acid  
Diluted, and Zinc added, its solution  
Changes from blue to green, then lavender,  
Finally becoming of a violet hue.  
Vanadium is found with some **Iron Ores**,  
Though in each case in minute quantity;  
And also with **Lead**—as **Vanadate of Lead**  
In trace, in our Cheshire Copper bearing beds.  
Vanadium is obtained from Lead Vanadate,  
By forming Ammonium-Vanadate,  
And decomposing by Electrolysis.



Tincture of Galls mix'd with Vanadic Acid  
Forms **Vanadium Ink**, a deep black fluid.

## FAYAN.

**ARSENIC**, the fool and villain's poison,  
Is a Metalloid of steel gray colour,  
Crystalline, lustrous, and very brittle.  
It tarnishes in Water, and in Air,  
Unless they are freed from Carbonic Acid.  
Heated in Air it volatilises  
Without fusion, but with rapid oxidation  
And smell like garlic, to **Arsenious Oxide**  
Call'd in trade **White Oxide of Arsenic**.  
Arsenic forms Salts in Metalloid law.  
It oxides to Arsen-ious and -ic Acids.  
Arsenate and Arsenite compounds,  
Are isomorphous with the Phosphorus Salts  
And, in many points, resemble each other.  
Powdered Arsenic, thrown into Chlorine,  
Emits light and heat, and forms the Chloride  
Of Arsenic, a volatile liquid.  
Arsenic combines with Bromine, Iodine,  
Fluorine, and will form two Hydrides with Hydrogen,

Arsenic Dihydride and Trihydride ;

The latter is called **Arsenuretted Hydrogen**.

Arsenic makes triple Salts with Sulphur and Metals.

Arsenious Oxide tastes feebly sweet

And astringent ; it's a very strong poison.

Arsenic Acid forms Salts with Alkaline,

Alkaline-earth, and some other metals.

Arsenic is found sometimes in **native** state,

It exists in moderate abundance

With Sulphur as **Realgar** (Disulphide),

And **Orpiment** (Trisulphide) ; 'tis also combined

In min'rals with Iron, Nickel, and Cobalt :

In trace it's found allied with Oxygen

In a great many **mineral Waters**,

**Mud of rivers, coal Smoke**, and, therefore, **town Air**.

Arsenic may be prepared by roasting

Its Metal Ores in Reverb'tory furnace

Having condense chambers or towers attached,

Crude Arsenious Oxide is freed and condensed ;

This is purified by sublimation,

'Tis then distill'd with Charcoal in a retort,

Carbon compounds are made in gaseous form,

And Arsenic is reduced to pure Metalloid ;  
It sublimes in a crystalline condition.  
Ars'nic in alloy is used to make metals white ;  
The Salts of Arsenic need care in preparation :  
If applied to wounds, they have pois'nous effect.  
Ars'nic Trioxide is used as strong flux in Glass.  
Realgar may be artificially formed  
By heating Arsenic Acid with Sulphur ;  
It's an orange-red fusible body,  
Used as a Pigment and to make "**White fire.**"  
The Trisulphide may also be form'd by Art,  
By fusing Ars'nic with proportion'd Sulphur ;  
It's a gold colour'd crystalline substance  
Much used as a Pigment. Cupric Arsenite  
(**Scheeles Green**) is poisonous and volatile,  
'Tis often used on Prints, and House-wall Papers !  
Arsenic that has been used to poison,  
Can, in very trace, be found through Dialysis ;  
The Antidote is the Ferric Hydrate  
(Freshly precipitated Ferric Oxide)  
This should be mix'd with water and drunk in time  
In which case it forms a remedy sublime.

## FEYAN.

**SELENIUM**, a Sulphur Associate,  
Is a reddish-brown solid Metalloid,  
Somewhat translucent, and of dull metallic glance,  
Insoluble in Water, and Alcohol.  
It exists crystalline, and vitreous ;  
At Water's boiling heat it melts and boils,  
Evolving odour like stale horse-radish ;  
Chemically it acts much like Sulphur  
And is found associated with that Element.  
Selenium combines with Oxygen ;  
It burns in Air, with blue flame, to Dioxide  
Which, with Water, forms Selenious Acid .  
Metallic Selenites resemble Sulphites ;  
There is also a Selenic Acid  
Which forms Selenates, isomorphous with Sulphates.  
All its Oxygen and Metal compounds  
Are decomposed by strong Acid or heat.  
Hydrogen Selenide is a heavy gas,  
Colourless, and with strong nauseous odour ;  
It's said, *pro tem*, to destroy the sense of smell.  
Selenium is very rare. 'Tis found native ;

Also, associated with Sulphur  
In certain kinds of **Swedish Pyrites**;  
And displacing Sulphur in **Lead Selenide**  
A mineral mined at Clausthall, Germany.  
Selenium is prepared from Selenide Ore  
Obtained from the Hartz Mountains, Germany;  
The Ore's treated with Hydrochloric Acid,  
The residue washed with Water and well dried;  
'Tis then ignited with equal quantum  
Of Black Flux, forming Potassium Selenide,  
This is dissolved out with boiling water;  
The solution, exposed to Air, through time,  
Absorbs Oxygen, and yields Selenium  
As a gray powder: for purification  
'Tis washed and submitted to distillation.

#### FTINE.

**BROMINE**, the only liquid Metalloid,  
Is an intensely deep dark-red liquid,  
Of odour akin to the other —INES;  
It irritates and acts as a poison;  
It's soluble in Alcohol, and Water;  
In Water it will bleach Organic bodies;

The colour disappears by Hydrogen  
Of the Water combining with Bromine,  
Hydrobromic Acid being thus form'd  
Oxygen is freed which oxides the colour :  
In these respects it much resembles Chlorine.  
In Bromine,—Antimony, Arsenic,  
And some few metals, burn with great splendour.  
Bromine with Oxygen forms Bromic Acid.  
Bromine is displaced by Chlorine in certain Salts ;  
It can be frozen to a black solid,  
It boils with Sun's rays on a hot summer's day.  
Bromine occurs combined with Magnesium,  
And Sodium, in certain **Saline Springs** ;  
And in **Seawater**, whence Seaweeds extract it.  
Bromine may be prepared from strong **Bittern**  
(Boiled Seawater from which Salts have been crystallized)  
By exposing to a stream of Chlorine,  
Then agitate the mixture with Ether  
In which the Bromine dissolves ; syphon off,  
Treat with Potash, and evaporate to dryness ;  
The product mix'd with dilute Sulphuric Acid,  
And Manganese Dioxide, is exposed .

To a low heat in a suitable Still,  
Bromine vaporizes and is then condensed.  
Bromine is also made from **Kelp** (charred Seaweed).  
Some Bromine Salts are used in Medicine,  
As Bromide of Potassium or of Mercury :  
Its Silver compound is used in Photography.

## GAYAN.

**TIN**, barter Ore of **De Anciente Britons**,  
Latin, STANNUM, is a silver-white Metalloid  
Which, when bent, crackles with the "cry of tin."  
Tin is soft, mall'able, ductile, and slightly  
Tenacious. Strongly heated in Air it fires ;  
The Oxide then form'd is call'd **Putty powder**,  
It is used to polish Glass and hard substances.  
Anhydrous Stannous Oxide is dense black,  
Touch'd with red hot rod, it burns like tinder.  
Tin oxides in Air but very slowly.  
**Tinstone** (Tin Dioxide) found in Mines and Streams  
In Cornwall, produces **Bar-** and **Grain- Tin**.  
It is our only native source for Tin.  
Tinstone also occurs in Mexico,  
Borneo, and Malacca, in small lodes.



The purest Tin is imported from Banca ;  
 The English Metal is generally impure.  
 For Tin, the Ore is first crush'd and well wash'd,  
 Then, with Charcoal and small portion of Lime,  
 Heated in a Reverb'tory Furnace,  
 Carbon Monoxide escapes, the Tin melts  
 And, with slag, falls to bottom of furnace ;  
 The cast Tin obtained is refined by re-fusing,  
 Pure Tin flows the first leaving impure behind ;  
 The Phœnicians and Romans made their Bronze  
 From Tinstone imported from Cornwall.  
 Tin Oxides are used in enamelling.  
 "Tin prepare liquor" (Sodium Stannate),  
 Stannous Chloride (Commercial "Tin Salts"),  
 And Stannic Chloride, are made on the large scale,  
 Very frequently direct from the Ore ;  
 Dyers and Printers use them for Mordants.  
 Mosaic Gold is Art-form'd Stannic Sulphide  
 Prepared in brilliant gold-colour'd scales :  
 It's used as substitute for Gold powder.  
 Tin melted with an equal weight of Lead  
 Makes "Soft Solder" used by Tinsplate Workers.

“**Britannia Metal**” is made with nine parts Tin  
In alloy with one part Antimony,  
And often a trace of Zinc or Bismuth.  
“**Tin-foil**” is Tin beaten to one thousandth part  
Of an inch in thickness ; it is frequently  
Corrupted with Lead. **Tinplate** is Sheet Iron  
First thoroughly cleaned between Sand, then steep’d  
In Water soured with Pyroligneous Acid,  
Or Sulphuric Acid, and lastly dipp’d in Tin  
In melted state ; the Tin thus covers the Iron  
And penetrates it completely. The best **Pewter**  
Is pure Banca Tin alloyed with Antimony ;  
Zinc is the chief body in common quality.

## GEYAN.

**ANTIMONY**, the type hard’ning metalloid,  
Latin, STIBIUM, has a bluish white hue ;  
’Tis lustrous, brittle, and easy to fuse ;  
It crystallizes in Rhombohedra,  
And is isomorphous with Arsenic ;  
It’s insoluble in Hydrochloric Acid.  
At white heat, in Hydrogen, it distils unchanged :  
Strongly heated in Air it burns, and gives off

Dense white fumes, **Antimony Trioxide**.  
Finely powder'd Antimony takes fire  
When thrown into Chlorine, with formation  
Of the Chlorides—**Tri- or Penta- Chloride**—  
According to the quantities employed.  
Antimony, as obtained by 'lectricity  
On positive pole, Copper wire negative pole,  
Explodes and takes fire when crack'd or broken!  
Antimony occurs **native**, and combined;  
Its principal Ore is the **Trisulphide**.  
Some Trioxide (Antimonious Oxide)  
Is found—as **Valentinite** and **Senarmontite**;  
The Tetroxide occurs in acicular crystals,  
As **Antimony Ochre (Cervantite)**;  
There is a compound with Calcium call'd **Romeine**,  
Also other compounds—as **Boulangerite**  
**Zinkenite**, **Feather Ore**, and **Fahl-ore**.  
Antimony is quickly reduced by heating  
Its Trisulphide Ore with metallic Iron;  
Ferrous Sulphide forms and Antimony is freed:  
As also when the Ore, mix'd with Coal, is heated  
In a Reverberatory Furnace.

Antimony in alloy of four parts,  
 With one part Lead, makes Printer's **type metal**,  
 Which will expand at moment of setting,  
 It thus takes a very sharp impression.  
 They use Antimony alloyed with Tin,  
 In place of Brass, for Machinery Bearings.  
 Antimony Salts are used in Medicine,  
 Though in excess they are highly pois'nous.  
 Potassium-Antimony-Tartrate (**Tartar**  
**Emetic**) is form'd from Antimony Trioxide  
 By boiling with Acid Potassium Tartrate  
 (Cream of Tartar). "**Glass of Antimony**"  
 (**Vitrum Antimonii**) is the Sulphide Ore  
 Imperfectly oxidized by roasting,  
 And partially fused in a furnace.  
 Antimony Pentasulphide, of colour  
 Golden-yellow, and red "**Kermes mineral**,"  
 Are poisonous objectionable pigments.  
 Antimony Trisulphide gives the "**blue light**"  
 That is used for Sea Signals during the night.

## GTYAN.

**IODINE**, a true caustic to diseased flesh,

Is a violet-colour'd solid metalloïd,  
Of dull metallic, plumbago lustre ;  
It exists in scales, plates, and splendid crystals,  
It is volatile at common temp'rature ;  
It only faintly dissolves in Water,  
But is freely soluble in solution  
Of its Alkaline salts, and in Alcohol.  
Starch solution, when touched with Iodine,  
Becomes of a beautiful blue colour ;  
If Iodine be in a combined state,  
Chlorine-water added proves its presence,  
Even though it exists in minute trace.  
Iodine will combine with Hydrogen,  
Forming Hydriodic Acid a gas,  
Colourless, fuming, and soluble in water.  
Iodine will unite with Oxygen,  
Forming Iodic and Periodic Acids,  
They will combine with metallic Oxides and water  
To form Iodates, Per-iodates, and Iodides ;  
High heat in each case destroys the compound.  
In effect, and volumetric bulk,  
The Iodates much resemble Chlorates.

Nitrogen Iodide is a black powder,  
When dry, it explodes with the slightest touch  
Of a feather, and, sometimes, spontaneously!  
Iodine is found in trace widely dispersed;  
Through Mexican and other **Silver Ores**;  
In some **Turfs, Coals, Slates**, and a few **Min'rals**.  
Appreciably in several **Fish Oils**;  
But chiefly combined with Sodium and Magnesium,  
In **Sea** and certain **mineral waters**;  
The commercial source for Iodine is **Kelp**  
(The half-vitrified ash of Seaweed) or charr'd Seaweed);  
Those substances yield, by lixiviation  
And evap'ration, a strong solution  
Of its Alkaline-metal, and other salts;  
Such thick liquor mix'd with Sulphuric Acid  
And Manganese Dioxide, is distilled  
Slowly, with care, and at low temperature;  
Iodine is freed, and its vapour received  
In condenser. It is afterwards purified.  
Iodine will tattoo the Skin for a short time.  
Iodine acts beneficially as medicine  
In small doses, internal or external;

In large quantum it acts as a strong **poison**.  
The curative virtue of Cod Liver Oil  
Is in great part due to this good element;  
The Oil, drunk in time, proves a blessing God sent.

## H A Y A N .

**TELLURIUM**, a Sulphur displacer,  
Is a bright and silver-like metalloid,  
With rhombohedral crystals like Arsenic ;  
'Tis brittle, and an indiff'rent heat conductor.  
It melts below red heat, and is volatile  
At white heat in current of Hydrogen.  
Tellurium is much like Selenium  
Both physically and chemically.  
In Ores it often substitutes Sulphur :  
Heated in Air it burns. It forms two Oxides  
Analogous to the Sulphur Acids ;  
Like Selenious Acid they are decomposed  
By Hydrogen Sulphide, and form a dark brown  
Eas'ly dissolved Tellurium Sulphide .  
Most Tellurites of Metals are soluble  
To greater or less extent in water.  
Telluric Acid will form in crystals.



Hydrogen Telluride is a colourless gas  
With smell like Sulphuretted Hydrogen.  
Tellurium occurs but in few Ores  
And always combined with Gold, Silver, Lead, or Bismuth.  
The chief Ore is **Bismuth Sulpho-telluride**,  
It is found at Chemnitz in Hungary.  
Tellurium is prepared from the Chemnitz Ore  
By powd'ring, and mixing with Sodium Carb'nate  
Equal weight pure and dry; this with Olive Oil  
Is made into Paste, and heated to near white heat  
In a closely covered Iron crucible;  
The Bismuth vapourizes, the fused mass  
Is then dissolved in water and exposed to Air,  
The Tellurium separates in solid state:  
It has no trade use up to the present date.

## H E Y A N .

**BISMUTH**, a metalloid named by Artists "Tin Glass,"  
Has pinkish-white colour, is of medium hardness,  
Brittle, very fusible, and, in Air, oxides;  
It melts at black heat, and vapours at white heat,  
Thrown in Chlorine it fires like Antimony,  
With production of Bismuth Terchloride.

Bismuth is found in **free** metalloid state  
Principally in Schneeberg, Saxony ;  
It occurs with Sulphur as **Bismuth Glance** ;  
And in most **Sulphuretted Copper Ores**  
Proportion'd like Silver in Galena.  
For preparation of the metalloid,  
Portions of rocks containing it are broken,  
And heated in a suitable furnace  
Thence the metalloid flows into Cast Iron Moulds.  
Bismuth compounds are used for Med'cine, and Paints.  
Bismuth is used to make "**Fusible Metal**"  
(Bismuth eight parts, Lead five, and Tin three parts) ;  
To take impressions from Dies, and make Toy Spoons,  
Spoons that ludicrously fuse in hot Tea.  
Mercury added to Fusible Metal  
Makes it more fusible, it has been so used  
To coat the inside of Glass-globe reflectors.  
Bismuth in alloy makes fine Printers' letters.



## THE SECOND GROUP OF ELEMENTS.

### METALS.

1st Klan.—IBYAN, IMYAN, ITYAN, JAYAN, JEYAN.

#### IBYAN.

**LITHIUM**, the lightest solid yet known,

Is a white colour'd metal that melts at low heat,

It soon oxides in Air, and, chemically,

Is closely allied both to Alkali

And Alkaline-earth Metals. Lithium

Occurs in minute proportions, chiefly

Combined as Chloride, in most Spring Waters,

In Milk, Tobacco, and also Human Blood;

In the Ashes of Plants, and Tryphylline.

Lithium is prepared by decomposition

Of Lithium Chloride by Electricity.

Lithium Carbonate is used medically

In aerated waters it's said to give ease,  
Nay, cure the Gout or Rheumatic disease.

#### IMYAN.

**SODIUM**, basic metal of Seaweeds,  
Named **NATRIUM**, is of silver-white hue,  
Very soft nature, and for Oxygen  
Has intense affinity. Placed in Water  
With organic matter, as Starch, it will ignite.  
Sodium compounds colour flame a strong yellow.  
Exposed to great cold Sodium is brittle ;  
It melts at boiling water heat, and is volatile  
In colourless vapour below red heat.  
\* Sodium is not acted on by Chlorine Gas  
Either whilst in fused state, or cold after fusion.  
Sodium Oxides Mon- and Di- are deliquescent,  
Yet will dry up again by absorption  
Of Carbonic Acid from the Atmosphere.  
Some one of the Sodium Salts exists  
In every speck of dust ; and, in primitive  
**Granite Rocks** in enormous quantities.  
**Sea-water** contains **Sodium Chloride**  
(**Sea Salt, Common Salt**) three per cent. nearly.

\* Wanklin.

Sodium's also found in **Minerals**

Combined with Sulphur, Boron, Carbon, Silicon, Oxygen, and in rock proportions with Chlorine.

The latter substance is known as **Rock Salt**.

The great sources for Rock Salt are Mines in Cheshire, Spain, Galicia, Tyrol, and Transylvania.

Metallic Sodium is easily prepared

When Sodium Carbonate, dried and pulv'ried,  
Mix'd with equal bulk of fine Coal or Charcoal,  
And ten per cent. of prepared common Chalk,  
Are thoroughly ground together and exposed  
To a high temp'rature in small Iron Stills ;

The Sodium distils, and is condensed

In vessels containing Min'ral Oil or Naphtha.

**Sodium Salts** are prepared extensively :

**Common Salt**, from strong Brine (cold water solution  
Of common **Rock Salt**) ; this is boil'd to near dryness,  
The crystalline product is sieved, and dried in stoves.

**Bay Salt** is the same but slowly crystallized.

For production of **Salt Cake**, and **Soda Ash**,  
Common Salt, placed in iron pan, is drench'd  
With proportion'd brown Vitriol, and roasted ;

**Acid Hydrochloric** (**Spirits of Salts**,  
**Muriatic Acid**) is then evolved,  
And its vapour condensed in the “scrubbing tower;”  
The residue “**Salt Cake**” (**Sodium Sulphate**)  
Is raked out, ground, mixed with Chalk or Limestone  
In equal weight, and Slack half its quantum ;  
The mass thrown into Reverb'tory furnace,  
Is constantly stirr'd whilst heating to fusion :  
The **Sodium Sulphate** is thus converted,  
By the Coal or Slack, into **Sodium Sulphide**,  
This, by the Chalk, changes to **Sodium Carbonate** ;  
When completed, this product call'd **Black-Ash**  
Is raked out and lixiviated ,  
Which leaves insoluble **Calcium Sulphide** ;  
The solution evap'rated, and the product  
Calcined with some Charcoal in a furnace  
Forms **Soda-Ash** (impure **Sodium Carbonate**).  
Another process recently introduced,  
Consists in passing, mix'd, **Sulphurous Acid**,  
Air, and Water vapour, in heated state,  
Through towers containing **Sodium Chloride** ;  
The vapour is made to permeate the Salt ;

A commercial Sodium Sulphate is thus form'd,  
Which is used for making fine **Soda-Ash**.  
Certain Sodium compounds are prepared  
From commercial Sodium Carbonate ;  
**Caustic Soda** (Sodium Hydroxide),  
A very powerful Alkali,  
By boiling it with Water and Lime, settling,  
And boiling solution down to dryness :  
Caustic Soda solution boiled with Fats ,  
Or Oils , makes various kinds of **Hard Soap**.  
Sodium Bicarb'nate with Tartaric Acid,  
Makes pleasant and slightly aperient drinks.  
**Ultra Marine Blue** (Lapis Lazuli);  
A min'ral found in China and Europe,  
Is the Silicates of Sodium, Calcium,  
And Aluminium,—with Sulphur combined :  
It is often made artificially.  
Sodium is much used for preparing  
Metals, Aluminium and Magnesium.  
Sodium Nitrate (**Chili Saltpetre**,  
**Cubic Nitre**) in Peru is found native ;  
In regular bed with Gypsum, Salt, and Shells



It is our chief source for **Nitric Acid** ;  
 'Tis also used as " Superficial Manure"  
 Called by agriculturists "**Top Dressing** :"  
 It gives a fine orange hue in Fireworks.  
 Caustic Soda will absorb free Chlorine,  
 Thus forming some "**Disinfecting Solutions**."  
 Sodium Sulphate known as "**Glauber's Salts**,"  
 From art or native source is a medical cure  
 And the chief flux in Glass manufacture.

## ITYAN.

**POTASSIUM**, the Plant's tonic metal,  
 Call'd **KALIUM**, of silver-white colour ;  
 Oxides when exposed to dry Air, producing  
 Potassium Monoxide ; thrown in water  
 It instantly fires ! forming the Hydroxide .  
 It can be viewed only through clear liquids  
 Which do not contain its friend Oxygen :  
 It cuts soft with knife at common temperatures ;  
 Its pure Salts colour blow-pipe flame purple ;  
 Its original source is soil from Felspar rocks,  
**Trees** thence extract it in form of **Potashes** :  
 The **twigs** yield most, and are burnt for **Pearl-Ash**

Extensively in America and Russia.

An available extraction process

Of Potassium Carbonate from Min'rals

Is to fuse **potassic rocks** with Calcium Carb'nate

And Calcium Fluoride, then lixiviate

And evaporate solution to dryness.

**Beet root** from Sugar Works, burnt, yields **Pearl-Ash** ;

The Salt from this source is pure and gainful.

Potassium Iodide, and Bromide,

Are extracted from **Kelp** (slow burnt Seaweed)

And charr'd Seaweed, by "The British Seaweed Company."

**Sea-water**, and certain **Prussian Salt-beds**,

Contain, and are worked for, Potassium Chloride.

Potassium Nitrate, and Chloride occur **native**,

The Nitrate as efflorescence on soils

Chiefly in East Indies. Potassium

Is prepared with risk, and great care, by heating

Mix'd dried Potash and Charcoal, in iron pots,

To high temp'ature ; Carbon Monoxide

Escapes, and the Potassium distils

Into vessels containing Min'ral Oil or Naphtha.

**Caustic Potash** (Potassium Hydroxide)

Is prepared from Potassium Carbonate  
(Pearl-Ash) By boiling it with Water and slaked Lime ;  
The clear liquor is boil'd down to dryness,  
Fused, and run into Moulds, or Sheet Iron drums.

Potassium Nitrate (**Nitre**, **Saltpetre**)

Is sometimes form'd by Art by well rotting  
Mix'd **Dung**, or **Flesh**, with Lime or old Mortar,  
Treating with stale **Urine** and exposing to Air,  
The mass lixiviated, and liquor boiled  
With Pearl Ash, then filtered, and crystallized, yields Nitre.

**Nitre** can be made by decomposing

Native Sodium Nitrate, in solution,  
With Potassium Chloride, or with Carbonate  
Obtain'd from **Ashes** of burnt waste Beet root.

**Gunpowder** is form'd of seventy-five parts  
Ground fused Nitre, with hard wood Charcoal  
Fifteen parts, and ten parts of roll Sulphur,  
Each sep'rately finely ground, weigh'd, and moist'ned  
With Water ; then under Edge-runner Mill  
Thoroughly ground together ; the mass produced  
Is tightly squeezed in a hydraulic press ;  
The Cakes, when broken, are placed in perforated

Vellum Sieves together with a loose wood roller,  
 The whole is then work'd by machinery ;  
 The resulting broken grit is sifted  
 Into **Powders** of diff'rent sized granules,  
 These are gently dried in steam-heated stoves  
 And "glazed" by self-wear in revolving kettles.  
 When Gunpowder is fired, the Oxygen  
 Of the Nitre combines with the Carbon,  
 Forming Carbonic-Oxide, and -Acid,  
 Nitrogen is freed, and Sulphur combines  
 With the Potassium, hence, Gunpowder  
 Can burn in closed space even under water,  
 Its needed Oxygen being self contained :  
 The explosive power is due to violent  
 Evolution and rapid expansion of gas  
 Developed by the sudden rise of temp'rature.  
 Manufacturers use Caustic Potash  
 To boil with Fish Oils to make **Soft Soap**.  
 For **Matches**, they use Potassium Chlorate.  
 Doctors prescribe all the—ides and the—ates.

JAYAN.

**RUBIDIUM**, an alkali metal,

Is of white colour and quickly oxides ;  
 'Tis a proved close ally to Potassium,  
 And Cæsium, in Chemical action.  
 With Merc'ry it forms a crystalline Amalgam  
 Of silvery lustre, but which, exposed  
 To Air or Water, instantly oxides.  
 A Rubidium Subchloride is blue like Smalt.  
 Rubidium occurs in small quantities  
 In **Min'ral Waters**, in **Plutonic rocks**,  
**Ash of Beet root**, **Tobacco**, **Coffee**, and **Grapes** ;  
 The chief source is Min'ral **Lepidolite**.  
 Rubidium is obtain'd from very pure  
 Rubidium Tartrate by electrolysis :  
 Being rare, its use receives little notice.

#### JEYAN.

**CÆSIUM**, a kin to Kalium,  
 Is a white easily oxidized metal  
 That closely resembles Rubidium,  
 And Potassium, in chemical properties ;  
 The **blue** Spectrum lines only prove its diff'rence.  
 Cæsium in combined state is widely diffused  
 Though existing in very minute quantities :

It is found in **Min'ral Waters**, **Ashes of Plants**,  
**Beet root**, **Tobacco**, **Coffee**, and **Grapes** ;  
 In **Pollux**, and Mineral **Carnallite** ;  
 The **Brine of Dürkheim** is its present richest source.  
 The fused **Cæ s i u m C h l o r i d e** if decomposed  
 Under **Merc'ry** by electric current,  
 Yields an amalgam which cold water oxides.  
**Cæ s i u m S u l p h a t e** will make an Alum,  
 There is no Art use yet for **Cæ s i u m**.

**2nd Klan.**—**JTYAN**, **KAYAN**, **KEYAN**.

#### **JTYAN.**

**CALCIUM** (combined) forms the **F r a m e M e t a l**  
**Of Animals** and the **Shelly exuviæ**  
 From wondrous **Coral Zoophytes**, and **Molusca**.  
 Calcium is a light yellow metal,  
 Exposed to **Air** it rapidly oxides,  
 'Tis ductile, and mall'able to paper thickness ;  
 It burns brilliantly when heated in **Oxygen**,  
**Chlorine**, or the vapour of **Bromine** or **Sulphur**.  
 It is found combined in blocks size of mountains

As **Limestone, Chalk, Gypsum, Plutonic Rocks, Marble and Coral beds.** **Min'ral Apatite** Is chiefly Calcium Phosphate. Calcium Is obtained by reducing its Chloride By Electrical decomposition.

Calcium Oxide (**Lime**) is Limestone burnt Between layers of Coal in upright Kilns ; Suffocating Carbonic Acid escapes And Lime is made in the Anhydrous state : It forms Calcium Silicate if overburnt.

Mix'd with water and sand, Lime makes **Mortar** Which, through time, re-takes Carbonic Acid from Air That *somehow* combines the Lime with Silica ; This causes Mortars and **Lime Cements** to harden. Lime dissolves freer in cold than hot water.

**Hydraulic Mortar** will set in Water ; It consists of carefully dried crude Lime with Clay, Silica, and Oxides of Iron ; water unites them And forms a hard compact mass, afterwards Insoluble in Water. Lime is largely used By farmers to destroy Organisms And free Potash from Soil for use of **Plants.**



Lime decomposes pernicious compounds  
 Of Iron in **Marshy**, and also **Peat**, lands.  
 Spring water in soil dissolves Calcium Salts  
 Such water, on evaporation in Boilers,  
 Deposits a crust Ammon. Chloride will dissolve.  
 Some **hard waters**, mix'd with Lime, become soft.  
 Calcium Sulphate (**Anhydrite, Gypsum**)  
 When found crystallized is call'd **Selenite**.  
 Gypsum, hot-dried in Oven and powder'd,  
 Makes "**Plaster of Paris**;" this material  
 Is used by Plasterers for casting Statues,  
 Medals, and Cornices for House Decorations;  
 Also by Pott'ry manufacturers for Moulds.  
**Scagliola** (apparent marble work)  
 Is form'd by slabs of natural Marble  
 Set in Plaster of Paris and polished.  
 Gypsum is much used when mixing certain  
 Kinds of Porcelain ware: 'tis ground for **Manure**,  
 And largely used for **sandy** and **grass lands**:  
 In Sculpture it's work'd as **Alabaster**.  
 Calcium Chloride, with Snow, freezes Water.  
 Calcium Phosphate is found in **bones** of Animals;

Disease reduces the quantum. The mineral  
Apatite is found in Cornwall and elsewhere,  
And is highly valued to make **Manure**.

**Bleaching Powder** is Calcium Chloride  
And Hypochlorite mix'd; it is prepared  
By passing Chlorine Gas over slaked Lime  
Laid in thin strata until saturated :

It is much used to bleach Linen and Cotton.

**Fluor Spar** ( Calcium Fluoride ) is found  
In beautiful and varied conditions ;  
Some kinds are used for Ornamental purposes,  
And as Flux at Iron and other furnaces.

#### KAYAN.

**STRONTIUM**, from Ore first found at Strontian,  
Scotland, is a dark yellow colour'd metal ;  
It speedily oxides in Air, or Water.

Its Salts tinge candle flame a fine crimson ;  
They act sometimes like Barium compounds.

Strontium Dioxide strongly heated, gives off  
Free Oxygen. Strontium combined is found  
In small quantities as **Strontianite**

(Strontium Carbonate) and **Celestine** (Strontium Sulphate ;

Those Minerals occur in small quantities,  
In some districts dissolved in Spring Waters. Strontium  
Is obtained by fusing Strontium Chloride  
And decomposing by Electricity.  
Strontium Nitrate when made into "Red Fire,"  
Causes a red light we greatly admire.

## KEYAN.

**BARIUM** forms Salts of dense gravity,  
It is a silvery white metal  
That rapidly oxides in air; 'tis ductile,  
And melts below redness, though not eas'ly vaporized.  
Barium resembles Strontium and Calcium.  
**Blood** with solution of Barium Chloride  
Remains fluid and does not putrefy.  
Barium is not found in metal state,  
But combined chiefly as **Heavy Spar** (**Barytes**)  
(**Barium Sulphate**) or **Witherite**  
(**Barium Carbonate**) twin minerals  
That form the vein-stones in many Lead Mines.  
Barium is obtained by Electricity  
From fused Barium Chloride by using amalgam'd  
Platinum wire as the negative pole;

The product when distill'd in Hydrogen

Leaves Barium in a tumefied mass.

Barium Dioxide has wondrous power,

When heated, of yielding free Oxygen

And, when cold, to re-absorb Oxygen

By exposure to atmospheric Air.

**Fibrous Spar (Bolognian (Barytes) Stone)**

Becomes, when well calcined, brightly phosphorescent.

With Barium Salts soluble Chromates

Produce a bright yellow precipitate.

Pyrotechnists obtain the hue in "**Green Fire**"

By adding Barium Nitrate. The Carbonate,

And prepared Sulphate, are used as Enamels

On address-cards, and House wall papers.

Ground Barytes is used to adultrate Paints,

And White Lead, though it has but little "body ;"

It's also largely used in common Pott'ry.

**3rd Klan.**—KTYAN, LAYAN, LEYAN, LTYAN, MAYAN, MEYAN.

KTYAN.

**ALUMINIUM**, the Bright Star of Metals,

The principal metal in common clay,  
Is extremely light, bright, and silver-like ;  
It does not oxide on exposure to Air  
Nor does its compact mass though ignited in Air ;  
Exhaled effluvia from towns do not affect it ;  
It may be cast or filed and is grandly mall'able ;  
Conducts Heat and 'lectric force like Silver ;  
It is fusible at a bright red heat ;  
Hydrochloric Acid dissolves it freely,  
Though Nitric Acid acts upon it but slowly.  
Aluminium is not found in native state ;  
**Alumina** its only Oxide occurs  
Nearly pure, as **Corundum**, **Ruby**, **Sapphire** ;  
**Emery** is similar but more impure.  
**Clay**, or Aluminium Silicate,  
Is **Felspar** decomposed by Air and Rain,  
The soluble Alkali being washed away.  
Nature's process is seen in perfection  
In certain parts of Devonshire, and Cornwall,  
Where the disintegrated Felspar from white granite,  
Contained in bare-faced weather beaten Rocks,  
Is found in great depths, and is of great value.

The rock through time changes to a mortar-like state.

**Shale** and **Slate beds** are ancient clay alter'd

By Iron, Silica Waters, and Bitumen.

**Marls** are Clays mix'd with Calcium Carbonate.

**Porcelain Clay (Kaolin)** is Felspar

Disintegrated and in very pure state,

Such is the white late form'd Clay of Devonshire

When freed by washing and sieving from Quartz and Mica.

The pretty crystal minerals **Garnet**,

**Idocrase, Mica**, and **Lepidolite**,

With zeolites **Stilbite**, and **Analcime**,

Are Silicates of Aluminium,

Plus Silicates of Alkaline Metals,

Or the near kinn'd Alkaline Earth Metals.

For want of a more economic process,

Aluminium is made from **Cryolite**

Direct, by reduction with Sodium ;

But such metal is usually impure.

It is better prepared by mixing

Chloride of Aluminium and Sodium,

Ten parts ; Fluor Spar, or Cryolite, five parts ;

With Sodium two parts, and heating the mixture

On Reverberatory furnace hearth.

After a short time the Air is excluded,  
Vivid goception takes place, intense heat  
Is evolved, and metal speedily produced ;  
The slag run out, leaves the Aluminium  
Mod'rately pure. The dross yields Alumina.  
The metal is employ'd by Opticians  
For delicate and ornamental work.

**Aluminium Bronze**, somewhat similar  
In appearance to Gold, is Aluminium  
Alloyed with Copper ; but Air in time affects it.

**Greenland Cryolite** is the Fluoride  
Of Aluminium and Sodium ;

It is used to prepare Aluminium,  
And, in Germany, to produce Soda.

Emery is used in the Arts for polishing  
Metals, Glass, and Stone. The common **Alum**

(Potash Alum of Commerce) is prepared  
From Shaly, or Clay Iron, Pyrites,

Which is gently roasted, damp'd, and long exposed  
To Air, when Aluminium Sulphate

And Ferrous Sulphate are form'd ; these are then



Dissolved out by lixiviation ;  
The water solution is then concentrated,  
And proportion'd Potassium Chloride added,  
Ferrous Chloride and Potassium Sulphate  
Now form, the latter with Aluminium Sulphate  
Combines and Alum in solution is form'd ;  
On further concentration, the Alum  
Crystallizes out. Alum is largely used  
To prepare skins. It yields **Alumina**  
A mordant for Dyers, Paper Stainers,  
And Calico Printers. Alumina  
With Dye Wood Liquors forms bright **Lake Colours**.  
Crude Alum is found native in some countries  
As **efflorescence** on Slate-clays, Shales, and Rocks.  
Porcelain, Crockery, and Earthenware,  
Are made of different Clays more or less pure ;  
The Clay (Kaolin) for **Porcelain** is mixed  
Generally with a little Felspar  
And Alkaline or Calcic Silicate,  
Which partly fuses, and compacts the clay when baking ;  
The presence of finely ground Silica,  
Or pulverised calcined Flints (Chert), reduces

The contraction and liability  
To crack when cooling. The ware is fashion'd  
In a lathe, or Plaster of Paris moulds,  
Then dried in Air, Stoved, and partly baked in Oven ;  
The figure is now dipp'd in prepared Glaze  
(A cream-like water mixture of Felspar,  
Gypsum, Silica, or Clay, with sometimes Pigment),  
'Tis then dried, put in a furnace, and well baked :  
The gilding or painting in enamel  
Is afterwards done, and flux'd in furnace.

“ **Crockery** ” is made from white second's Clay  
Mix'd with ground Barytes, or calcined Flints ;  
When half baked, Prints with Enamel Pigments  
Are laid on, the figures are “ fixed ” by stove heat,  
Afterwards the paper is washed off, and the pots dried ;  
They are then dipped in a water-mixed Glaze  
(Lead Oxide chiefly), and finished in Oven.

“ **Earthenware** ” is of the commonest clay ;  
It is coated with “ Salt Glaze ” by throwing  
Common Salt in the hot baking furnace,  
The Clay is attacked by the Salt vapour  
Forming adhesive Fusible Silicate

Which well resists Water and weak Acids.

**Bricks** are made of any non-sandy Clay,  
 With ground Flints, Marl, or Kaolin sometimes added ;  
 The clay, or mixture, temper'd and moulded by hand  
 Or machine, is then burn'd in Stacks, Kilns, or Vaults :  
 The hue of brick is due to native Min'ral Salts.

#### ALUMINIUM ;

OR,

#### THE BRIGHT STAR OF METALS.

He who propounds the plan of reducing  
 Aluminium from our Rocks or Clays,  
 In the brief time and cost of Iron Smelting,  
 Will lime-light Earth with yet grander Art days,  
 By urging new trades with electric force plied,  
 Giving wealth and work, to full height of Man's pride.

Then try good Youth, if but a brief essay,  
 The ores you own in *profound* abundance,  
 The skill exist within the brain-mine ? *yea*,  
 So go *band* them with all Art complaisance ;  
 In thy life we'll award thee, tribute, and fete,  
 And own-metal scroll thee for Time beyond date.

#### LAYAN.

**YTTRIUM**, a metal of great scarceness,  
 Is known only in blackish gray powder ;

Its Oxide (Y t t r i a) is yellowish white  
 In colour. Yttrium never yields a Spectrum.  
 Yttria is found in **Yttrotantallite**,  
 In **Orthite**, (each extremely rare min'rals),  
 And **Ytterbite** from Ytterby, Sweden.  
 By ignition you can obtain Yttrium  
 From Yttrium Chloride and Potassium.

## LEYAN.

**CERIUM**, a metal with intermixing Oxides,  
 Is in gray powder that pressure makes lustrous :  
 It soon oxides in air, or cold water.  
 Cerium Oxides P r o -, S e s -, and P e r -, can unite  
 With each other. Its Hydrated P r o t o x i d e  
 Changes in Air from white to yellow hue ;  
 If then heated, it forms red S e s q u i o x i d e .  
 The Protoxide is found in **Cerite**, and **Orthite** ;  
 The Fluoride occurs near Fahlun, Sweden.  
 Cerium may be obtained by heating  
 Anhydrous Protochloride of Cerium  
 In crucible, together with Sodium.

## LTYAN.

**LANTHANUM**, a graphite-like metal,

Is a dark lead-gray powder, soft to the touch,  
 And which, when hard press'd, adheres in compact mass.  
 Its Oxide turns red litmus paper blue.  
 Iodine added in small quantum will colour  
 A mass of the newly prepared white Oxide blue.  
 The S a l t s of Lanthanum are colourless.  
 Lanthanum is found with Cerium minerals ;  
 As a P h o s p h a t e in **Monazite, Cryptolite,**  
**Apatite,** and certain **Cobalt Ores.**  
 Lanthanum is reduced from Lanthanum Chloride  
 By heating with Sodium ; the Salt is washed out,  
 With Alcohol, until it is pure without doubt.

## MAYAN.

**DIDYMIUM**, Lanthanum 's twin metal,  
 Is a grayish metal that water oxides.  
 Concentrated solutions of its Salts are red.  
 The Oxide is n o t Alkaline to test.  
 Didymium is never found in metal state  
 It always occurs in conjunction  
 With Lanthanum, sometimes through Cobalt Ores,  
 Or with Cerium in Swedish min'als  
**Monazite, Edwardsite,** and **Cryptolite.**

Metallic Didymium you may prepare  
 By heating Potassium with excess  
 Of Didymium Chloride ; then rinse it well  
 With cold water, until the Salts you expel.

## MEYAN.

**ERBIUM** is a dubious metal  
 Not yet isolated in metal state.  
 E r b i a, the Oxide, has a fine rose tint.  
 Erbium S a l t s are more or less bright rose colour'd.  
 Erbia is found with Yttria in general,  
 In Gadolinite a Swedish mineral.

4th Klan.—MTYAN, NAYAN, NEYAN, NTYAN, OBYAN.

## MTYAN.

**BERYLLIUM**, metal of the Beryl  
 And Emerald gems, is a white metal,  
 And light much like Magnesium. It is oft named  
 GLUCINUM from the sweetish taste of its Salts.  
 It may be forged and roll'd into sheets, like Gold.  
 B e r y l l i a, its Oxide, resembles  
 Alumina, though it does not yield an Alum ;

Beryllium is found combined with Silicon  
 In **Euclase**, **Phenacite**, **Leucophane**, and **Emerald** ;  
 The **Aquamarine** or precious Beryl  
 Is often green, with shades of yellow to blue-green ;  
 There are some few blue, rose, and water Beryls.  
 Fine Beryls are found through the Mourne Mountains  
 In **Granite** ; and through **Clay-Slate** beds in Europe  
 And America ; Peru yields the best gems.  
 Beryllium may be obtained by passing  
 The vapour of its Chloride o'er melted Sodium ;  
 The product you may in this manner produce,  
 When wash'd, is fused to "button" ready for use.

#### NAYAN.

**MAGNESIUM**, a metal that yields light much like Sun,  
 Being rich in chemically active rays,  
 Is a soft silver-white metal, that fuses  
 At low heat, and can be distilled at red heat.  
 It acts very like Alkaline-Earth metals,  
 And has great electro motive power,  
 It may be drawn to wire or pressed to ribands ;  
 Moist air soon oxides Magnesium, dry air will not.  
 It is found as Carbonate with Calcium Carb'nate



In **Magnesium Limestone (Dolomite)**,  
In some Mineral Springs, and Sea Water.  
It also occurs as **Borate, Phosphate, Sulphate,**  
And **Nitrate**, in Minerals and Waters.  
**Magnesium Silicate** forms the principal part,  
With other Silicates, of **Steatite**  
(**Talc, Soapstone**), **Hornblende, Augite**, and of **Jade**;  
**Chromium** and **Ferrous Oxides** give them  
Their varied shades of colour. **Serpentine**  
Is **Magnesium Silicate** and **Hydrate**.  
**Meerschaum**, Ore of the Smoker's baneful pipe,  
Is almost pure **Magnesium Silicate**.  
**Magnesium** is now produced on the large scale,  
By heating the **Magnesium Chloride**  
With **Sodium**; **Sodium Chloride** is formed,  
And **Magnesium** as metal set free.  
The light obtained by burning **Magnesium Wire**,  
In arranged Spirit Lamp, Photographers use  
In dark caverns as substitute for Sun.  
**Magnesium Oxide (Magnesia)**, when form'd  
By igniting **Magnesium Nitrate**,  
Becomes by long immersion in water

A Hydrate as dense and tough as Marble,  
But more translucent and with greater hardness.  
Magnesium Sulphate (when prepared, term'd **Epsom Salts**)  
Is found as a **natural** deposition  
On the floors of Kentucky Limestone Caves;  
And also occurs in laxative spring waters.  
Magnesia is calcined on a commercial scale;  
'Tis used as Aperient when children ail.

## NEYAN.

**ZINC**, our valued galvanizing metal,  
Has a lamellar crystalline structure,  
Bluish-white hue, and slowly oxides in air,  
It seems chemically a kin to Magnesium.  
Zinc is brittle at common temp'ratures  
And at 200 degrees Centigrade;  
At sixty degrees less heat it is mall'able;  
For **Sheet Zinc** it is at that stage roll'd or hammer'd;  
Most remarkably after such treatment  
And cool'd, it is still found malleable;  
Zinc burned in air gives a bright greenish flame.  
Melted Zinc exposed to air will oxide  
With great rapidity, forming "Flowers of Zinc"

Frequently termed "**Philosophical Wool.**"

The chief Zinc Ores are **Blende** (Zinc Sulphide)

**Calamine** (Zinc Carbonate), Zinc Silicate

And the rarer Ore Red Oxide of Zinc,

Each is obtained in Mines through Britain and Europe ;

"**Black Jack,**" mined in Britain, is Zinc Sulphide.

Germany and Belgium yield the most Ores.

For Zinc, the Ores, powdered, are first roasted

By exposing at high temp'rature to Air,

This brings either Ore to the state of Oxide ;

It is then mix'd with fine Coal or Charcoal,

And heated in large Earthenware retorts,

Carbon Monoxide escapes, and Zinc distils,

As metallic vapour, into Clay condensers.

Zinc strips, with dilute Sulphuric Acid,

Are largely used to make Hydrogen Gas.

Sheet Zinc is often used for Roofing buildings.

Iron and Copper articles intended

For use in damp place, or in Sea Water,

After being first dipp'd in "p i c k l e"

(Strong Hydrochloric Acid), are **Galvanized**

By a brief immersion in melted Zinc ;

They are then for a long time weather proof :

When Sheet Iron or vessels are thus coated

The film of Zinc acts in Electric circuit,

In which it is the more Oxidable

Or positive metal, the quality

And part Zinc plays in Galvanic Batt'ries.

One class of Calamine gently heated,

Or rubb'd, is very strongly electric.

“ **Zinc White**” (Zinc Oxide) makes a useful white Paint.

Zinc Sulphate (trade **White Vitriol**) is obtained

From lixiviated half-roasted Blende ;

The liquor is boil'd down, and the Salt crystallized :

It is astringent, and used for emetics.

Zinc Sulphate is a remedy for weak eyes.

Liquid Zinc Chloride, with Ammon. Chloride,

Is used to scour the surface, ere they solder

Or tin vessels made of Iron or Copper.

#### NTYAN.

**INDIUM**, a cousin german to Zinc,

Is a soft, white, highly lustrous metal,

Like Platinum in colour. 'Tis ductile,

And will mark paper or receive a polish,

It remains bright in Air or boiling Water,  
 And fuses as easily as Lead. It burns  
 With violet tint in flame of Bunsen's burner.  
 Indium in trace is found in the **Blende**  
**Of Freiberg**, in Zinc from it; in **Wolfram**;  
 In **Flue-deposit** of Zinc furnaces  
 At Goslar; and in German **Black Blende (Christophite)**.  
 Indium in metallic state is obtained  
 By reducing its O x i d e with Soda-flux  
 On Charcoal 'fore blowpipe flame. 'Tis but little known,  
 A technical use for it has not yet been shown.

## OBYAN.

**CADMIUM**, with features like Tin, and Zinc,  
 Is a white metal with slight tinge of blue;  
 It has strong lustre and takes a fine polish.  
 It "crackles," and is mall'able and ductile  
 Like Tin. 'Tis very volatile at low heat.  
 Cadmium S u b o x i d e is a green powder  
 Resembling the Oxide of Chromium.  
 Cadmium heated in Air, fires and oxides.  
 Cadmium is found in small quantum through **Zinc Ores**  
 As S u l p h i d e, C a r b o n a t e, and S i l i c a t e,

In Derbyshire, Cumberland, and Hanover.

Cadmium Sulphide as found near Greenock,  
Scotland, is the only pure native compound ;

It has diamond glance, with honey yellow shade  
Which changes to carmine red when heated.

Cadmium comes over first when distilling

Certain Zinc Ores ; to free from Zinc, it is dissolved  
In Acid, and Cadmium as Oxide thrown down ;

This Oxide yields pure Cadmium when mix'd

With ten per cent. Coal and distill'd in Retort.

Photographers use Cadmium Iodide,

Oil Artists "**Jaune Brillant**" (the yellow Sulphide).

**5th Klan.**—OMYAN, OTYAN, RAYAN, REYAN, RTYAN, SAYAN.

#### OMYAN.

**CHROMIUM**, source of the bright Chrome Yellows,

Is a bright metal, that crystallizes in cubes ;

It is exceedingly difficult to fuse,

A heat that will vapourize Platinum

Is insufficient to melt Chromium.

Chromium has great affinity for Oxygen.

Chromium Dichloride colours Water blue.

The dry Trioxide will inflame Alcohol,

Chromium Sesquioxide being form'd.

Chromium occurs as **Lead Chromate** (**Red Lead Ore**),

But more abundantly as **Chrome Iron Ore**

(Chromium Oxide and Iron Oxide combined)

Chiefly in Sweden, the Shetlands, and America.

The Sesquioxide gives the green hue in **Serpentine**.

Chromium exists in **Meteoric Iron**.

Chromium is reduced from its Oxides,

Or Chlorides, by mixing with one third Lampblack

And exposing in crucible lined with Char

To prolonged intense heat of Blast furnace :

Chromium may also be reduced

By the action of metal Sodium

On Chromium Trichloride at red heat :

Or, by exposing mixture of Chrome Oxide

And Potassium Cyanide to a white heat

In a covered porcelain crucible.

Chrome Iron Ore fused with Potassium Carbonate

Yields soluble Potassium Chromate ;

Acid Sulphuric added to this, separates



Large red crystals of **Bichromate of Potash**.

Chromium Sesquioxide is much used

As a green pigment on Porcelain.

It also stains Glass to a fine green tint :

Green of the **Emerald** is due to this Oxide.

**Chrome Alum**, is Chromium Sulphate combined

With Potassium or Ammonium Sulphate ;

The crystals are of a deep purple hue.

“**Chrome Yellow**” is form'd by adding a Lead Salt

To Bichromate of Potash solution :

Having a strong colouring body

It is used by Painters, Dyers, and Printers.

Bichromate of Potash with Acid Hydrochloric,

Will bleach Palm Oils : a process exceedingly quick.

#### OTYAN.

**MANGANESE** is a favouring metal

Of whose innate virtues we must know more.

It is of reddish white colour, brittle,

And hard enough to scratch Glass or hard Steel.

It decomposes Water at any heat,

With evolution of Hydrogen Gas.

It must be kept under Naphtha. Like Iron

'Twill combine with Carbon and Silicon.

Its Salts have pink, rose, or deep purple hues.

Manganese Ores are pretty abundant,

They exist as Carbonate and Oxides :

**Braunite** is Manganic Oxide ; **Hausmannite**

(Manganese Red Oxide) : **Pyrolusite**

Is Black Dioxide found in Warwickshire

Though chiefly imported from Germany.

Manganese compounds in minute trace

Are often found in the **ashes of Plants.**

Manganese is obtained, with difficulty,

By fiercely heating its Oxides with Char

In a crucible made of Caustic Lime.

The Oxide tinges melted Glass purple.

Manganese *per se* is not used in Arts

But its Oxide, when thrown in Blast furnace

With Iron, is worked for certain class Steel.

Manganese Dioxide evolves Chlorine

From Hydrochloric Acid ; a trade use.

“ **Cassel Green,**” a pigment, is now prepared

By igniting Manganese Dioxide

Fourteen parts, with eighty parts of Nitrate

And six parts of Sulphate, of Barium ;  
The green fritted mass is triturated  
With water, and then mixed with gummy matter.

**Manganese Silicate Spar** is of rose red hne,  
It is carved into ornaments in Devonshire.

Manganese Heptoxide, strongly heated,  
Yields Oxygen together with Ozone.

Potassium Permanganate, treated  
With Sulphuric Acid, ozonizes  
Air in quantity with facility.

**Condy's Fluid** is a Manganese Salt  
Which, in contact with gaseous offal,  
Will disinfect by freeing Oxygen,  
Sweet'ning such airs as are noxious to men.

#### RAYAN.

**IRON**, the Lever of Britain's Commerce,  
Named FERRUM, is a bright, white, and tough yet soft metal;  
Its dust when pure, fires when exposed to Air ;  
Iron is magnetic from cold to red heat ;  
It requires a very high heat to fuse ;  
When cast, its structure is crystalline cubes ;  
Hot Iron hammer'd is granular, when roll'd, fibrous.

Rusting of Iron is due to Carbonic Acid

Not to Oxygen or pure water'd Air.

**Meteoric Iron** is pure from other worlds,

Its blocks sometimes weigh tons of good metal :

Many small masses are found on Earth's surface

In South America and other parts.

As Oxide, Iron is almost universal ;

It exists in **Rocks, Soils, Plants**, and is essential

Component of the **Blood of Animals**.

The **Red** lees in the Water from Coal Mines

Is due to Iron Carbonate and Oxide.

The chief Ores are **Specular Iron : Red and Brown**

**Hæmatite** (Ferric Oxide with Water .

Sometimes combined), and **Clay Ironstone**, often

Favouringly existing near to Coal Seams.

British districts for Iron Works are South Wales,

Wolverhampton (Black Country), Ulverstone,

Glasgow, and Motherwell. Excellent Iron Ores

Exist in Sweden and many countries.

From Sweden we import the finest Iron.

**Clay Ironstone** (Ferrous Carbonate with Clay)

Being in Britain the most abundant source,

This Ore is first roasted, Carbonic Acid  
Escapes, and impure Ferric Oxide is form'd,  
This, with Limestone (as flux) and Coal, is thrown  
Into Blast Furnace ; hot Air then led by tuyeres  
And blown upwards through mass, makes the heat intense :  
Fed from above, the metal settles down  
And is reduced by Carbonic Oxide Gas,  
First to porous metal, then impurities  
Of Ore (Clay and Sand) with the Lime unite,  
And make a fusible Silicate slag :  
The hot metal then unites with Carbon  
Of the Fuel, and forms a crude Cast Iron,  
Which in flowing to bottom of Furnace  
Unites with Silicon of the Silica ;  
This metal run out in Sand forms **Pig Iron**.  
Heat from Furnace was formerly wasted,  
It now forms a kind of superheater  
By which the Air-blast for furnace is made hot.  
For the manufacture of **Cast Iron**  
Pig Iron with or without old scrap metal,  
Is again melted with hard Coke fuel  
In small Blast furnace, from thence 'tis drawn and pour'd

Hissing and scintillating, into sand moulds,  
“ Faced ” with S.P. Blacking, forming **Cast Iron**,  
(Iron with Carbon and Silicon combined).

Such is the metal of our street Gas Lamps,  
Palisading, Common Pans, and Fire-grates ;  
Sewer-pipes, Water-pipes, and Engine Bed-plates.

**Wrought Iron** is Cast Iron refined whilst melted,  
And “ puddled ” by burning out impurities  
(Carbon, Silicon, Sulphur, and Phosphorus)

In current of Air in Reverb'tory furnace ;  
At one stage it thickens, it is then roll'd  
Into large balls, hammer'd to make it cohere  
And squeeze out slag ; then, dazzling, sparking, 'tis roll'd  
Into “ plate ” iron, or “ bar ” iron, round or flat.

Portions of such wrought Iron will weld or blend,  
According to purity of metal

And clean surface, strangely, below melting point.

Wrought Iron is used to make Gas Pipes, Spades, and Nails ;  
Machinery, Anchors, Chains, and Water-pails.

**Steel.** Bar Iron heated with Charcoal in close chests  
Until it absorbs a trace, forms “ **Blister Steel** ; ”  
This melted in furnace forms “ **Crucible Steel** ; ”



'Tis sometimes made direct from Iron and weighed Carbon,  
Or **Spiegeleisen** (Ore of Iron, Carbon, and Manganese).

**Bessemer Steel** is made from melted Hæmatite Pig  
Or Cast Iron, by forcing hot Air through it  
Until the impurities are burnt out ;

At this stage a weighed portion of Spiegeleisen  
Is added to virtuously re-Carbonize ;

The Steel is then run out into ingot moulds.

**Siemens-Martin Steel** is made from Pig Iron,  
Free from Sulphur and Phosphorus, melted  
And mingled at a welding heat with Wrought Iron,  
Some Spiegeleisen being also added :

Ingots of this Steel have great solidity.

**Whitworth** has, by Air-pressure to molten Steel,  
Made Steel for Cylinders, supremely solid.

Thanks to such men we have excellent Armour plates,  
Railway Axles, Steel Rails, and strong Boiler plates.

Steel is primely adapted for cutting-tools ;

When well "temper'd" 'tis used for Penknives, Razors,  
Watch-Springs, Bayonets, Needles, and Scissors.

"**Mall'able Iron**" is Cast Iron annealed  
By imbedding Castings in powder'd Ore



Or earthy material, submitting  
To red heat, and occupying days to cool down ;  
Such castings being tougher are call'd "mall'able ;"  
For wear and rough work they are much more durable.  
Perfectly pure Iron is of silver white hue,  
With strong lustre ; 'tis form'd when Iron Nitride  
Is heated below the melting point of Lead  
In Hydrogen stream : such Iron can be cut with knife.  
Iron with trace of Tungstic Oxide hardens like steel.  
Steel with a one-fifth per cent. of Silver,  
"Silver'd Steel," makes fine Surgical instruments.  
Ferrous Oxide colours common Glass green.  
Ferrous Sulphate (Green Vitriol, Copperas)  
Is obtained from Air-oxidized Iron Pyrites,  
By lixiviation and crystallization :  
'Tis used for making Ink and deep black Dyes,  
And is also employed by Photographers.  
Ferric Oxide forms a red-brown Pigment.  
Ferrous Salts are light green and magnetic ;  
Ferric Salts yellow and non-magnetic.  
Iron Citrate, and Chloride, are tonic Salts.  
Iron Disulphide (Pyrites) when roasted in Air

Yields Sulphurous and Sulphuric Acids :  
 The dregs yield a small quantum of Copper.  
 Crude Iron Peracetate (**Iron Pyrolignite**),  
 Is largely used by Calico Printers.  
 "**Prussian Blue**" (Ferric Ferrocyanide  
 Somewhat impure) is dissolved for **Blue Ink** ;  
 And is used by Printers and Paper Stainers.  
 Certain choice kinds of compact red Iron Ore  
 Button makers use to burnish gilded buttons.  
 M a g n e t i c (Black) O x i d e (**Min'ral Loadstone**),  
 Whose magnetic virtue the air improves,  
 Is one of the most valuable Iron Ores  
 For making Steel, hence esteem of Swedish Ores.

IRON, THE LEVER OF BRITAIN'S COMMERCE.

SLAVE IRON, the lever of Britain's commerce,  
 Work'd by the genius of Man,  
 Now spans waters vast, TRADE-WEALTH to disperse,  
 Fulfilling God's foredestined plan.

True Iron honour serves in our country's need,  
 True as Steel 's the TYPE of a man,  
 Honour MUST be till'd where choked by ill weed,  
 God speed to the speediest plan.

Tough Iron is jannak and with Vigour graft,  
 Tough as Iron 's the PROOF of a Man,  
 String up your sinews, like the BEARING-SHAFT  
 In the Civilization Van.

Then with IRON, COAL, and COTTON together,  
 Three GEMS to a Lancashire Man,  
 We'll ward wind and weather, and reap Earth's treasure,  
 So give praise to Old Iron and klan.

## REYAN.

**COBALT**, a metal that yields bright blue colours,  
 Is a reddish-white tenacious metal,  
 Strongly magnetic, and needs great heat to fuse.  
 Cobalt is not found in metal state, but allied  
 With Arsenic as **Tin White Cobalt**, or with Sulphur  
 As **Cobalt Glance**. Cobalt may be prepared  
 By fusing its O x i d e in Hydrogen ;  
 Or igniting its Oxalate in crucible.  
 Cobalt compounds give bright colours, well suited  
 For Pigments. In the making of Stain'd Glass  
 Cobalt Oxide gives a splendid blue colour.  
 Cobalt Chloride forms "**Blue Sympathetic Ink**"  
 Made visible only when the paper is dried.  
 "**Smalt**" is a crude glass colour'd by Cobalt ;  
 It's made by fusing roasted Cobalt Ore  
 With Potass. Carb., and Quartz Sand free from Iron ;  
 The product ground fine is used to blue tint  
 Paper and Linen. **Cobalt Ultramarine**,

A finer blue colour, is made by heating,  
 To redness, Alumina with Cobalt Phosphate  
 Or Cobalt Arsenate. Zinc Oxide with Cobalt Salts  
 Make a fine green hue. “Zaffre” is Cobalt Oxide  
 Well mingled with Vitriifiable earth;  
 An Art-compound used to give blue colour  
 To Glass, Enamels, and Porcelain pure.

## RTYAN.

**NICKEL**, the lustrous metal in German Silver,  
 Is a white, tough, malleable metal,  
 Strongly magnetic when cold. Some hydrated  
 Nickel Salts have bright emerald green hue:  
 The anhydrous Salts have a yellow hue.  
 Nickel is found in moderate abundance  
 Combined with Arsenic as **Kupfernickel**,  
 And with Cobalt in **Speiss**, in Germany  
 And Sweden. Some **Meteorites** contain Nickel.  
 Nickel is best prepared by treating  
 Its Ores with Acid, from which solution the **Oxide**  
 Is precipitated, dried, mixed with Charcoal,  
 And reduced in fireproof Clay cylinders  
 In powerful furnace: by remelting

And moulding the metal, **Nickel ingots** are form'd.

Nickel is used to make **German Silver**,

An alloy of one hundred parts Copper,

Sixty of Zinc, and forty of Nickel ;

Being malleable and of great lustre,

'Tis used by the Optician and Jeweller.

SAYAN.

**URANIUM**, whose ore is used to stain Glass,

Is a steel-white colour'd metal. In Air

Does not oxide at ordinary heat,

But, heated strongly, it burns brilliantly.

Uranic Salts are yellow. Uranoso-

Uranic Oxide is velvety green.

Uranium exists but sparingly

In nature, and always in combination :

In the min'ral **Pitchblende** it's an Oxide ;

And in **Uranite**, a Phosphate. Uranite

Is found in beautiful emerald green crystals,

Perfect, and form of the right square prism,

Chiefly in Saxony, Bohemia,

And in Ore veins of Tin mines in Cornwall.

Uranium is obtained as fused metal,

By heating a mixture of Uranous Chloride  
And Potassium Chloride, together  
With Sodium, in a Charcoal lined  
Inner crucible in an Air furnace ;  
The metal is left pure by water-washing.  
Uranous Oxide stains Glass a fine black,  
Uranic Oxide—a beautiful yellow.  
Photographers now use Uranium Salts.  
Sodium Uranate, on Porcelain,  
Forms a yellow pigment with orange shades  
To black, with different glaze and heat applied.  
Ammon. Uranite is **Uranium Yellow** ;  
This Salt changes when a red heat is applied,  
To green Uranoso-uranic Oxide.

**6th Klan.**—SEYAN, STYAN, TAYAN, TEYAN.

#### SEYAN.

**ZIRCONIUM**, Silicon's friendly metal,  
In crystallized state forms hard brittle scales  
Like Antimony for colour and lustre ;  
It fires at a red heat in Chlorine Gas.



Hydrate of its Oxide (**Zirconia**)  
Resembles Hydrate of Alumina.  
Zirconium combined with Silica,  
Is found in **Zircon** and some rare min'rals.  
Zirconium, like Silicon, exists  
In the states, **Amorphous**, **Graphitoidal**,  
And **Crystalline**. Amorphous Zirconium is made  
By passing vapour of Zirconium Chloride  
Over metal Sodium in red hot  
Porcelain tube ; the metal is then well wash'd.  
To intensify the Oxy-hydrogen light,  
To make more lasting and a better radiant,  
Zirconia's used as **coating** for cylinder  
(Or covering for the Lime or Magnesia).

**STYAN.**

**NIOBIUM**, an extremely rare metal,  
Obtain'd only as yet in black powder,  
Oxides with incandescence when heated in Air,  
Forming the compound Niobic Oxide.  
Niobium is frequently allied  
With Tantalie Acid in **Columbite**,  
**Samarskite**, and in other minerals.



Metallic Niobium is prepared  
 By heating Fluoride of Niobium  
 With Sodium, then treating with cold water,  
 Which dissolves out all soluble matter.

## TAYAN.

**TANTALUM**, twin brother to Niobium,  
 As metal is obtained in black powder ;  
 Heated in Air, it burns to T a n t a l i c A c i d .  
 It is found in minerals **Columbite**  
 And **Tantalite** in many North countries.  
 Tantalum is form'd as metal on heating  
 Fluotantalate of Potassium  
 Or Sodium, with metallic Sodium ;  
 The mixture is covered with Potassium Chloride  
 In Iron crucible with the lid made secure,  
 This keeps out the Air and leaves the metal pure.

## TEYAN.

**THORIUM**, a very rare metal,  
 Is a gray powder with metallic lustre  
 Which, heated in Air, burns with great splendour,  
 Producing T h o r i a , snow-white whilst hot,  
 Yellow when cold. Thorium does not exist native,

But combined with Silica in **Thorite**  
 Found in Norway, and in min'ral **Monascite**.  
 We can obtain metallic Thorium  
 By reducing its Chloride with Sodium.

**7th Klan.**—TTYAN, UBYAN.

TTYAN.

**MOLYBDENUM**, found in Copper Smelter's "bear,"  
 Is a tin-white and very hard metal ;  
 Heated in Air it forms yellow **Trioxide**.  
 A chief Ore is Molybdenum Disulphide  
 (**Molybdenite**) in semblance like Graphite,  
 It having strong lustre and lead-gray colour,  
 With quality to gray streak paper like Plumbago ;  
 Also Molybdate of Lead (**Yellow Lead Ore**).  
 Molybdate of Iron constitutes the "bears"  
 Found on the hearths of Copper furnaces.  
 Molybdenum may be obtain'd by exposing  
 Its Oxide (Mon., Di., Tri.), or Ammonium Compound,  
 To white heat in crucible lined with Char ;  
 To melt to "button" shape needs heat long continued.

Molybdenum Trioxide, heated to full redness

In stream of Hydrogen, yields pure metal.

In Laboratory, Molybdic Acid

Is used as test for Phosphoric Acid.

#### UBYAN.

**TUNGSTEN** (WOLFRAM), a hardener of Steel,

Is a white metal, very hard and brittle ;

At red heat in Air, it forms Tungstic Oxide .

**Tungstic Tungstate** (Tungsten Pentoxide)

Is a blue substance. “Wootz” or Indian Steel

Contains Tungsten. Common Horse-shoe Magnets

Of Steel, are immensely more magnetic

If the Steel contain a trace of Tungsten.

Tungsten is tolerably abundant,

It exists in Cornwall in min’ral **Wolfram**

(Iron and Tungsten with trace of Manganese combined).

Elsewhere it is found as Calcium Tungstate

(**Scheelite**), and **Scheelite** (Lead Tungstate).

Tungsten is prepared by strongly heating

Tungstic Oxide in stream of Hydrogen.

Tungstic Acid is a lemon-yellow powder,

Fix’d and insoluble in Acid Waters ;

It's obtained by heating Calcium Tungstate Ore  
 With Nitric Acid, and then well washing.  
 Tungsten Ore is sometimes added to Steel,  
 To impart hardness. **Tungstate of Soda**  
 Renders light fabrics u n i n f l a m m a b l e .  
 Potassium and Sodium Tungstates  
 In Dyeing now oft displace the Stannates.

8th Klan.—UMYAN, UTYAN.

#### UMYAN.

**THALLIUM**, a metal of mongrel qualities,  
 Physically closely resembles Lead,  
 It has bluish white lustre, and soon oxides in Air,  
 It can be cut with knife or pressed into wire,  
 Streaks paper like Plumbago, crackles like Tin,  
 'Tis volatile at white heat, in Hydrogen  
 At red heat. It imparts to colourless flame  
 A characteristic fine g r e e n colour.  
 When T h a l l i c O x i d e is triturated  
 With "Flowers of Sulphur" it **detonates** !  
 If triturated with eight parts Gold Sulphide,

In a short time it begins to take fire !  
Thallium Monoxide is much like Potash,  
With water it yields an Alkaline Caustic ;  
The solution absorbs Carbonic Acid  
From Air ! forming Potassium-like compounds.  
Its Sulphate will combine to form Alum.  
Thallium Salts are highly **poisonous**,  
Thallious Iodide, like Mercuric Iodide,  
Changes by heat from yellow to scarlet ;  
When cold, with friction, it returns to yellow hue.  
Thallium when found in Iron Pyrites,  
Apparently takes the place of Arsenic  
Usually found in that mineral.  
It exists in some Copper Pyrites,  
And Sulphurs, whence 'tis obtain'd in deposit  
In certain Sulphuric Acid chambers.  
It is found through certain **Metals, Waters**,  
And occasionally in **Ashes of Plants**.  
Thallium Sulphate is found in the **Flue-dust**  
Of Pyrites' Burners : Thallium  
Is reduced from this Salt by Electrolysis ;  
Or by precipitating in pulverent form

By placing strip Zinc in Thallium solution.

Thallium is rare, and has no trade production.

#### UTYAN.

**LEAD**, the indispensable to Plumbers,

Named PLUMBUM, is a bluish gray metal,

With strong metallic lustre when newly cut,

But which tarnishes on exposure to moist Air.

Lead is very soft, may be drawn to wire

Or roll'd to sheet, has little tenacity,

Melts at low heat, and in part vapours at red heat.

Water containing Air dissolves exposed Lead.

**Grain'd Lead** decomposes pure boiling water

Evolving Hydrogen and forming Lead Oxide.

**River water** in Lead pipes forms compact Suboxide

Which protects the Lead from further action.

Lead is not found in the metallic state

But combined in more than twenty Min'rals.

The chief Ore is **Galena** (Lead Sulphide).

This contains a gainful trace of Silver.

For Lead, Galena, mixed with Lime portion

To form Slag with impurities, is roasted

In Reverb'tory Furnace ; Air there oxides it,



Sulphur Dioxide escapes, and Lead as Sulphate,  
Sulphide, and Oxide, now exists. The mass  
Is thoroughly mix'd, Air excluded and the heat raised,  
Then the elements react on each other ;  
Sulphur Dioxide is again form'd and freed,  
Lead remains, which, run in moulds, forms **Pig Lead**.  
Melted Lead freely dissolves chance present Silver ;  
To separate, they crystallize out the Lead  
By slow cooling in Iron pots, till Mother-Lead  
Contains three hundred ounces Silver to the ton ;  
Then it undergoes "**cupellation**" in furnace,  
Where, on bone earth bed and under blast of Air,  
Lead oxides, fuses, runs, and sinks away ;  
The Silver remains in the metal state.  
Lead for **Shot**, is harden'd with trace of Arsenic,  
Heated from Air, and then g r a n u l a t e d  
By pouring into Water, at a height  
Of from ten to one hundred and fifty feet,  
Within a tower, this makes Shot **coarse** or **fine**.  
"**Plumber's Solder**" is coarse Tinman's Solder,  
Two parts Lead alloyed with one part Tin.  
**Sheet Lead** is used for Roofing and Cisterns.



Many Lead Compounds are employed as Paints..

Hot Lead oxides in Air to Monoxide

Of straw colour, this when fused, forms "**Litharge.**"

Lead Monoxide fused in Clay crucibles

Rapidly dissolves out their Silica

Forming Fusible Silicate or Glass

(The **Lead Glaze** used for common Earthenware).

"**Massicot**" is Lead Monoxide reddened

By long exposure to Air at low heat.

"**Red Lead**" is mix'd Lead Mon- and Di- oxides

Form'd by oxidizing Lead, or Massicot,

Through contact with Air, at moderate red heat,

The Oxygen absorbed adds to its weight ten per cent.

Red Lead is used to make joints for steam-pipes ;

As Paint ; and to manufacture Flint Glass.

"**Sugar of Lead**" is trade Lead Acetate.

"**White Lead**" is Lead Carb'nate and Hydroxide,

Call'd also **Ceruse** : it is form'd by placing Lead strips

Above Vinegar in earthenware jars,

And packing the jars in stable Manure,

Or spent Bark, for sev'ral weeks ; White Lead forms,

Carbonic Acid from the putrid refuse

Slowly displacing Acetic Acid.

“**Patent Yellow**” is Lead O x y c h l o r i d e ,

Usually prepared by heating Litharge

With ten per cent. of Sal-ammoniac.

Lead and its Salts are in high degree **poisonous**,

Epsom Salts is the remedy instantaneous.

**9th Klan.**—VAYAN, VEYAN, VTINE.

#### VAYAN.

**COPPER**, the Siamatic bond metal

’Tween integral parts of British Empire,

And Britain with all important nations,

Is a yellow tinged red colour’d metal,

Named CUPRUM, moderately hard, ductile,

Very tenacious, and melts at white heat.

It conducts Heat and Electricity grandly.

Copper in moist Air rusts, partly to green Carb’nate ;

Burnt in Air, it coats with Suboxide and Oxide.

Copper since ancient times is found in **native** state

In medium quantity. Of many minerals,

The chief Ores are the **Yellow Copper Ore**

(**Copper Pyrites**, Copper and Iron Sulphides),  
**Copper Glance** (**Redruthite**, Cuprous Sulphide),  
**Red** (Cuprous) **Oxide**, and, **Malachite**  
(Beautiful green Cupric Carbonate). Cornwall  
Yields us Ore which, with that imported from Chili  
And Australia, is smelted chiefly in Wales.  
Copper is easily reduced from Red Oxide,  
Or Malachite, by heating with Carbon  
And portion of fine Sand, in a Wind Furnace.  
To produce Copper from Copper Pyrites,  
The Ore is roasted repeatedly,  
Thus partially converting to Oxide ;  
Then the Ore, with Sand added, is melted  
In a Reverberatory Furnace,  
The Iron oxides and combines with Silica  
Forming a light and fusible scum slag ;  
Impure Cuprous Sulphide sinks to the bottom,  
And is known as the “**mat**” or **coarse metal** :  
Repeating this process, makes “**fine metal**”  
(Purer Sulphide) : this again fused in Air,  
Cupric Oxide forms, and acts on the Sulphide,  
Sulphur Dioxide is freed and near **pure metal** left :

The last Oxygen is compell'd to depart  
 By "poling" the mass with a stick of green wood.  
 Copper, in plate or sheet, is used for Boilers,  
 Stills, Pumps, Bolts, Nails, and Cloth Printers' Rollers.  
**Gun-metal** is Copper with ten per cent. Tin.  
**Bell-metal** has twenty per cent. ; and brittle  
**Speculum Metal** about thirty per cent. Tin.  
**Bronze** for Statues is principally Copper  
 Alloy'd with Tin and trace of other metals.  
**Brass** is Copper alloy'd with one third Zinc,  
 With sometimes trace of Lead. **Yellow Metal**  
 (**Muntz Metal**), used for sheathing ships' bottoms,  
 Contains sixty per cent. Copper. Alloys  
 Of Copper are hard and brittle if slowly cool'd,  
 But soft and tough if placed red hot in water.  
**Hard Solder** (**Spelter Solder**), for Copper  
 And Brass joining, is Brass, with more Zinc added  
 In quantum from five to sixteen per cent.  
 Cuprous Oxide stains Glass a beautiful red ;  
 The tint given by Cupric Oxide is green.  
 Cupric Sulphate (**Blue Vitriol**) is form'd  
 By oxidizing native Sulphide (**Covellin**,

**Indigo Copper**): also from **Copper-scales**  
(**Rust**) by dissolving in Sulphuric Acid,  
Evaporating, and crystallizing :  
It is used in making Dyes and Pigments.  
The deep blue crystal mineral **Azurite**  
Is a Cupric Carbonate. The blue pigment  
“**Verditer**” is art-form’d Cupric Carbonate.  
**Scheele’s Green**, Art form’d Cupric Arsenite,  
Is a bright green insoluble powder  
Used by Paper Stainers and Cloth Printers.  
Copper will **deposit** from its solutions  
Upon an exposed bright surface of Iron :  
’Tis thus easy to plate Iron with Copper.  
Cuprous Chloride solution, most strangely,  
Absorbs Carbonic Oxide Gas from Air.  
**Verdigris** is Bi-acetate of Copper  
Used as Pigment and for dyeing Hats black.  
In case of Copper poisoning, take **white of eggs**.  
The “**Silv’ring**” of **Brass pins** is an easy matter,  
Simply boiling them with Tin filings and Tartar.

## VEYAN.

**SILVER**, the proverbially bright metal,

(ARGENTUM), is of a bright white colour  
With brilliant lustre, not affected  
By pure Air. Silver Suboxide is black,  
The Monoxide is brown. Silver is the best  
Known conductor of Electricity  
And Heat ; 'tis extremely ductile ; fine Silver wire  
Of seventy-eight one-thousandth inch diameter  
Will support one hundred and eighty pounds weight  
Without breaking. Sulphur, if present in Air,  
In time tarnishes Silver articles.  
Melted in Air, Silver is remarkable  
By absorbing twenty two times its bulk  
Of Oxygen, but when solidifying,  
In cooling, it " spits " it out again.  
Silver has been found in the **native** state  
Since earliest times in many countries ;  
And it occurs combined with Sulphur, Chlorine,  
Bromine, Antimony, Arsenic, Iodine,  
And often gainfully with Lead in **Galena**.  
Germany has extensive Silver mines.  
The chief Silver mines are in the Andes mountains  
In both North and South America.



Silver is sometimes found combined with Gold.

“**Horn Silver**” is native Argentic Chloride.

Dark and light **Red Silver Ores** are Sulphides.

For Silver, in Germany, the Ore is roasted

In furnace with Common Salt, the Sulphide

Is thus changed into Chloride, the mixture

Is then roll'd, with scrap Iron and Water, in casks,

The Silver separates in the metallic state ;

Mercury then being added the crude Silver,

With Gold if present, dissolves : the Amalgam

Distilled leaves Silver in unrefined state.

Vide the Oratorical Verse on Lead

For extraction of Silver from Galena.

Silver when alloy'd with trace of Copper,

Is used to manufacture **Silver-plate**.

Our Silver coins contain about seven per cent,

Of Copper, the French coinage has ten per cent.

“**Silver Solder**” consists of equal parts

Silver and Brass, plus one sixteenth of Zinc :

Jewellers use it for nearly all metals.

Silver Nitrate, moulded, forms “**Lunar Caustic**,”

'Tis used for Wounds, Hair dyes, and marking Linen.



**Light**, colours purple prepared Silver Chloride  
Partially decomposing to Acid  
Hydrochloric, and, Argentous Chloride :  
In the presence of Organic matter  
The change is rapid, hence phenomena  
In the Photographer's art : a solution  
Of Sodium Hyposulphite dissolves out  
The unalter'd Silver Chloride, therefore  
'Tis used to "**fix**" photographic pictures.  
Silver "**Wash**," "**Leaf**," and "**Japanners' Silvering**,"  
Are done precisely the same as \*Gilding,  
But employing Silver in place of Gold.  
Copper may be **bright silver'd**, by friction,  
With mixture of six parts Tartar, Common Salt  
Six parts, Alum one and a half parts, and Silver  
Deposited from Silver Nitrate solution  
By Copper ,one part ; then polishing with leather.  
Dial plates of Clocks, and Thermometer scales,  
Are silver'd somewhat similar but **deader** hue.  
To **Electro Silver-plate**, first prepare  
Silver solution :—take Potassium Cyanide  
Solution, one and a quarter ounce to gallon

Of water, and cause Galvanic current  
To dissolve the needed amount of Silver  
By placing a porous cell in, and fill'd  
To equal height with, the Cyanide liquor ;  
A plate of Copper should then be placed in the cell  
And connected with the Zinc terminal  
Of a Battery. In the outer liquor  
Is placed a sheet of pure Silver metal  
Link'd to Copper terminal of Batt'ry,  
Which working, in a few hours' time, produces  
The needed Argento Cyanide solution.  
To plate well, take of Silver one ounce to gallon ;  
A coat thick as writing paper requires,  
To each square foot, three half ounces of Silver.  
For Silver-plating, metals well adapted  
Are Copper and Brass, but the best is German Silver.  
The articles are first dipp'd in " p i c k l e "  
(Mix'd strong Sulphuric and Nitric Acids)  
They are then thoroughly wash'd with water,  
Steep'd in Mercurous Nitrate solution,  
And, finally, suspended in Silver Solution  
By wire link'd to the Zinc pole of Batt'ry ;

The Silver begins at once to veneer  
 And in a few hours' time forms a thick plate.  
 A **Fulminate of Silver** is made similar  
 To that of Gold, but is more powerful,  
 Indeed it detonates so violently  
 That one dare not make more than grain with safety.

## VTINE.

**MERCURY**, our weather indicator metal,  
 (QUICKSILVER), in Latin, HYDRARGYRUM,  
 Has blue silver-like hue, with splendid lustre ;  
 'Tis the only metal known to be liquid  
 At common temperatures. When frozen,  
 At minus forty degrees Centigrade,  
 It is solid, crystalline, and mall'able.  
 Pure Mercury, roll'd on tray, leaves no train.  
 When to Air exposed, 'tis sensibly volatile ;  
 Mercury will not tarnish in dry or moist Air.  
 At high heat in Air, it changes to **Red (Mon-) Oxide**.  
 Mercury heated in Chlorine ignites,  
 Producing the "**Corrosive Sublimate**"  
 (Mercuric Chloride) ; also form'd by subliming  
 Mercuric Sulphate and dry Common Salt

Equally mix'd : factors use this method.  
Solutions of the Mercurial Salts  
Deposit Mercury on Copper plate  
Or Sheet Iron, which friction makes silver-like.  
Mercury is found as metal, and, combined  
With Sulphur as **Cinnabar**, in Australia,  
Japan, China, Spain, and California,  
“**Horn Quicksilver**” (Chloride) is a rare Mineral.  
Mercury is obtained from Cinnabar,  
By roasting in furnace and conducting  
The vapours to a condensing chamber  
Or through earthenware pipes ; Sulphur Dioxide  
Is form'd and freed, and the Mercury sublimes.  
Mercury is largely used for construction  
Of Barometers and Thermometers.  
It is employed for “silvering” Mirrors,  
By rubbing an even surface of Tin foil  
With Mercury, thus forming an Amalgam ;  
This, with Artist's skill, is then applied to the Glass.  
Mercury Amalgamates readily  
With some metals, such as Gold and Silver,  
And remains fluid up to saturation, :

It is used to extract those metals from their Ores.

Hazardous **Fulminate of Mercury**,

Mix'd with Gunpowder and drop of Varnish,

Is the charge for rifle **percussion caps** ;

Commoner Fulminates rust the nipple.

“ **Holton Mirrors**” are plain or stain'd Glass globes

Silver'd by amalgam of one part Bismuth,

Half parts Lead and Tin, and two parts Mercury ;

The solid metals are mix'd by fusion

And Mercury added when the mass is near cold :

The interior of such globes is veneer'd,

By pouring in the amalgam whilst warm

And fluid : the excess is pour'd out and re-used.

“ **Vermillion**,” of beauteous red hue,

Is prepared Mercuric Sulphide sublimed.

“ **Blue Pills**,” and “ **Gray Ointment**,” contain Mercury

In fine division. “ **Red precipitate**,”

Used by druggists, is Mercury Monoxide.

The best **Calomel** (Mercurous Chloride),

For medical purposes, is prepared

By pouring Mercurous Nitrate solution

Into water containing trace of Salt.

All Salts of, and finely divided Mercury,  
Are strong poisons ; white of eggs is the remedy.

10th Klan.—WAYAN, WEYAN, WTYAN, YAYAN, YEYAN,  
XTYAN, ZKYAN.

## WAYAN.

**RHODIUM**, Platinum's natural ally,  
A metal of almost silver-white hue,  
Is hard to fuse yet very mall'able ;  
Insoluble *per se* in all Acids,  
Though Aqua Regia dissolves its alloys.  
Its Sesquioxide solution is rose colour'd.  
Rhodium Trioxide is a blue powder.  
Rhodium forms double Salts with Chlorine  
Plus Potassium ; efflorescent prisms.  
Rhodium alloys with most metals but not Merc'ry ;  
Rhodium in powder, heated in Air, oxides.  
Rhodium is found with **Platinum Ores**  
In a native alloyed metallic state  
In Brazil, Ceylon, and other countries.  
Metallic Rhodium is best obtained,

From prepared Sodium Chloro-rhodate,  
 By reducing under Hydrogen, and washing.  
 Rhodium is used, in alloy with Platinum,  
 By Chemical factors for Stills and Pans ;  
 Also, by Chemists for furnace vessels.  
 Steel alloyed with a trace of Rhodium,  
 For some purposes is valuable.  
 Pens tipped with Rhodium are durable.

## WEYAN.

**RUTHENIUM**, Platinum's faithless friend,  
 Is a gray white metal very difficult  
 To fuse ; Aqua Regia dissolves it slightly :  
 'Tis easier oxidized than Platinum.  
 Ruthenium forms five different Oxides.  
 With its solutions, Hydrogen Sulphide  
 Yields a splendid sky-e-blue colour'd filtrate.  
 Ruthenium is found in metallic state  
 In small quantities in **Platinum Ores**  
 As one of the six comrade metals ;  
 And, in **Osmiridium** (**Iridosmine**)  
 Both in the scaly and granular species.  
 Ruthenium is obtained in pure state



By igniting its dried Sesquioxide  
In Hydrogen ; lumps of porous metal are form'd  
Which, in compound flame, if placed in the hottest part,  
Will fuse “ to button.” It has no use in Art.

## WAYAN.

**PALLADIUM**, Platinum's cozening cousin,  
Is a white metal but darker than Platinum,  
About as hard but not quite so ductile ;  
It forges, and partly oxides in the forge fire,  
Like Silver it “ spits” absorbed Oxygen.  
Palladium dissolves in Min'ral Acids ;  
Fused with Char, it becomes very brittle :  
It precipitates in **spongy** state and will then weld.  
Ammonia in excess with Palladium-  
Dichloride yields a fine rose-red powder.  
Palladium in fine state, floated on water,  
By transmitted light is of blood-red hue.  
**Palladium** foil at one hundred Centigrade,  
Will condense six hundred and forty three times  
Its volume of Hydrogen ; in sponge form  
It absorbs only ninety times its bulk.  
Palladium is found in octohedral grains

Mix'd with grains of Platinum, in Brazil,  
And, alloy'd with **Gold**, through **Lead Selenide Ore**.  
Palladium in pure state is prepared  
From its chief source, alloyed **Platinum Ore**,  
By digesting in Aqua Regia, the liquor  
Is decanted, and Platinum thrown down  
By Ammonium Chloride, 'tis then filter'd,  
And Palladium thrown down by Merc'ry Cyanide ;  
'The product calcined yields Palladium  
In the form of a gray and spongy mass.  
Palladium is sometimes used for Chemists' weights.  
One per cent. Palladium hardens Steel.  
Palladium with ten per cent. Silver  
Has been used by Dentists, to make suction-plates ;  
And Palladium Amalgam, for stopping teeth.  
P a l l a d i u m S a l t s, Iodine will precipitate  
From weak solutions ; 'tis a test most delicate.

#### YAYAN.

**GOLD**, the value-type metal through past time,  
Irresistibly magnetic to all men,  
Named AURUM, is a brilliant yellow metal ;  
In thin films by transmitted light 'tis green .

Gold is the most mall'able of all metals,  
One grain can cover fifty square inches !  
It is as soft nearly as Lead ; does not tarnish  
In pure Air or Water at any heat ;  
At high temp'rature it is somewhat volatile.  
Gold is not affected by Sulphur or Acid  
When *per se*, except Selenic Acid.  
**Sunlight** decomposes Gold Trioxide.  
Stannous Chloride with weak Gold solution  
Forms the beautiful "**Purple of Cassius.**"  
Gold is found in m e t a l state in **crystals,**  
**Dust, nuggets,** and combined with other metals,  
Alloyed in nearly all cases with Silver.  
In fine trace 'tis very widely diffused  
Through **Sedimentary** and **Plutonic** rocks.  
"Gold dust" deported by mountain torrents  
Is found in **detritus** of some rivers.  
America, Australia, and Cape of Good Hope,  
Are our chief sources for the valued metal.  
Gold was from certain Iron Pyrites  
Extracted before "Gold fields" were discovered.  
Gold is separated from sand or detritus

Containing it, by washing in a "cradle"  
Or trough, when the mud and light mineral  
Are washed away, whilst Gold being heavy  
Sinks to the bottom. For extraction of Gold  
From Auriferous Quartz, or sandy rock  
The stone is powder'd, mix'd with Mercury  
Which dissolves out the Gold, thence freed by distillation.  
Gold is usually **refined** by fusing it  
With Silver and then treating the alloy  
With strong Nitric or Sulphuric Acid :  
This dissolves dross metals and leaves the Gold pure.  
At the Royal Mint, Sidney, a current  
Of Chlorine in crucible has been tried  
With success ; the Gold resists the Chlorine,  
Whilst dross metals form floating slag Chlorides :  
When these are pour'd off, the Gold is cast into **ingots**.  
For Gold Dust, Californians form **water torrents**  
By aqueducts led from a near mountain lake,  
These are spouted on loose sandy Auriferous rock,  
The detritus passes o'er a Mercury trough,  
And Gold, sinking through the wood grating, dissolves.  
The Standard Gold for **coin** in Great Britain

Is Gold eleven parts with one part Copper ;  
'Tis harder and more fusible than pure Gold.  
Gold alloyed with Silver acquires a green shade.  
" **Gold leaf**" is made from pure Gold plates, roll'd out,  
And further thinn'd by hamm'ring to required  
Degree of fineness between strips of Vellum.  
An easy way to gild Copper articles  
Is to boil them in Auric Chloride mix'd  
With excess of Sodium Bicarbonate.  
" **Gold Wire**" is usually gilt Silver Wire.  
" **Gold Lace**" is lightly gilded Silver wire.  
" **Gold Thread**" is yellow silk thread cover'd  
With flatten'd gilt wire wound round by machinery.  
**Gilt** may be applied to metallic, composite,  
Plaster, paper, leather, or wood surfaces.  
" **Gold Wash**" or " **Water Gilding**," for common work,  
Is veneering by Gold dissolved in Mercury :  
Heat removes Mercury from a metal surface.  
In " **Leaf Gilding**" the article is sized  
Which cements Gold leaf afterwards laid on.  
In gilding **Steel** the metal is rough'd, heated,  
And Gold leaf laid on with a burnisher.

**Japanners' Gilding** consists in using  
Gold dust or powder in place of Gold leaf.  
To "**Electro-gold plate**" (**Electro-gild**)  
Repeat method as for \*Silver-plating  
Replacing Silver with Gold and heating,  
The Auro-Cyanide solution formed,  
By Steam in a jacketed Iron vessel.  
To gild well use one ounce of Gold to the gallon.  
Gold plating is perform'd on Silver Articles  
Thoroughly cleaned before their immersion  
In the Gold-depositing solution.  
In gilding Iron, Tin, or Lead, 'tis usual  
To plate them with Copper, then to Gold plate.  
Gold solution with excess of Ammonia  
Precipitates "**Gold Fulminating Powder** :"  
It is also made by well digesting  
Auric Oxide with Ammonia liquor ;  
When heated, or struck by hammer, it explodes.  
"**Purple of Cassius**" enamel painters use.  
Oxide of Gold stains Porcelain copper-red.  
Artists use Sodio-Aurous Hyposulphite,  
For "fixing" in a good Daguerreotype.

\* Vide page 170.



## YEYAN.

**PLATINUM**, the Chemists' pot metal,  
In colour is bright white, and never tarnishes  
In any case in pure dry, or moist, Air ;  
'Twill not oxide or fuse in a blacksmith's fire,  
And melts only by heat of Compound Blowpipe flame  
Or Electricity. At high temperature  
It will weld like Iron, and may then be compacted.  
Whether hot or cold 'tis very mall'able.  
Platinum is insoluble in common Acids  
But is acted on by Aqua Regia,  
Or Caustic Alkalies when highly heated.  
Platinum, in state of fine division  
(**Spongy Platinum**) has wondrous faculty  
Of condensing gases on its surface.  
Platinum Dioxide is brown; the Dichloride  
Is an insoluble green powder. "**Platinum-black**"  
Gocepts Formic Acid to Carbonic Acid,  
And Alcohol to hot Acetic Acid,  
The great heat oft'times causing to inflame !  
Platinic Oxide digested with Ammonia  
Forms a kind of **Fulminating Platinum** ;



Also produced by Potash solution  
With Ammonium-platino Chloride ;  
It is a straw colour'd, dangerous powder.  
Platinum forms Salts with Ammonium.  
Strip Zinc will precipitate Platinum  
In fine state from its Acid solutions.  
Platinum is comparatively rare,  
'Tis always found **native**, and chiefly alloy'd  
With five other metals, **Palladium**,  
**Osmium**, **Iridium**, **Rhodium**,  
And **Ruthenium**, found in Siberia,  
Brazil, Ceylon, and some other places.  
Such alloy occurs sometimes with Hyacinths,  
With traces of Gold, and other metals,  
In small **grains**, roll'd masses, scales, and nuggets,  
Is found in stream **detritus**, **sand**, and **gravel**, from Rock  
Though not *in situ* in the original rock.  
For the preparation of **Platinum Alloy**  
The Ore of mix'd metals is placed in furnace  
Heated by Compound Blowpipe flame, and fused ;  
By this means a pure alloy of Platinum  
With Iridium and Rhodium is form'd ;

Other constituents and impurities,  
Are, by the intense heat, volatilized ;  
This alloy is preferr'd to pure Platinum :  
Large boilers, though enormously costly,  
Are often made of this alloyed metal,  
And used for concentrating Sulphuric Acid.  
In the Laboratory, Platinum  
Is very useful for forming Capsules,  
Platinum Wire, Spatulas, and Crucibles.  
Metallic vessels may be **Platinum coated**  
By Mercury Amalgam and highly heating.  
Small metallic objects are **platinised**  
By mere contact action with **Platinic Oxide**  
(Which has been thrown down in presence of Grape Sugar)  
Common Salt at the same time being added.  
Steel unites with Platinum in all proportions  
Forming a good alloy for cutting-instruments.  
“**Artificial Gold**” consists of Copper  
Seven parts, Platinum sixteen parts,  
And Zinc one part, fused together under Charcoal.  
Platinum is used for figures on Pottery,  
And in certain coins of Russian currency.

## YTYAN.

**IRIDIUM**, Platinum's twin companion  
And to which it has a great resemblance,  
Is a white and brittle metal that fuses  
With difficulty in the Compound Blowpipe flame.  
Iridium is insoluble in Acids  
In compact state, even in Aqua Regia,  
But as precipitate from solutions,  
Or when largely alloyed with Platinum,  
It forms when treated with Aqua Regia,  
Iridium Bichloride; in the process  
It dissolves with rainbow-like changing colours.  
Iridic Oxide is an indigo hued,  
Moderately stable, bulky powder.  
An Ammonia compound is violet hued.  
Iridium is found in **Platinum Ores**,  
And with Osmium in **Osmiridium** :  
It always occurs in metallic state.  
Iridium is reduced from made Chloride  
Of Iridium and Ammonium,  
By ignition; the metal thus obtained is pure.  
Iridium in natural alloy

With Platinum has several Art uses,  
As, for Crucibles and Dental purposes.

## ZKYAN.

**OSMIUM**, Platinum's fickle associate,  
In pulverulent state is black, in compact state  
Is a dark gray, moderately lustrous, metal  
Sufficiently mall'able to be roll'd.  
Osmium is soon powder'd, and promptly inflamed,  
Burning with powerful offensive odour  
That resembles Chlorine or Iodine.  
Osmium is the most refractory of metals ;  
At extreme high heat it is volatile.  
Osmium, heated in Chlorine, colours to blue black  
Afterwards forming red Osmium Tetrachloride.  
Osmium occurs **native** with Iridium  
In the alloy'd Ore call'd **Osmiridium** ;  
Through **Platinum Ores**; and, also, with **Chrome Iron**.  
Pure Osmium is best obtained, it would seem,  
By igniting its Salts in Hydrogen stream.

# NAMES OF ELEMENTS

DETECTED IN CERTAIN

## NODULES OF MATTER

OBSERVED THROUGH THE

SEA OF SPACE.



The Metalloids are arranged according to their chemical energy,

The Metals according to their klan and chemical energy.



NAMES OF ELEMENTS PROVED (BY SPECTRUM ANALYSIS) TO EXIST IN THE FOLLOWING SUNS (FIXED STARS):—

ALPHA (*a*) LYRÆ VEGA.

METALS: Sodium, Magnesium, and Iron.

BETA (*b*) PEGASI.

METALS : Sodium, Magnesium,

And perhaps Barium.

 $\alpha$  ORIONIS.

METALLOID : Bismuth.

METALS : Sodium, Calcium, Magnesium,

And Iron.

## POLLUX.

METALS : Sodium, Magnesium, and Iron.

## SIRIUS.

METALLOID : Hydrogen.

METALS : Sodium, Magnesium, and Iron.

## THE SUN.

METALLOIDS : Hydrogen and Titanium.

METALS : Sodium, Calcium, Barium,

Magnesium, Zinc, Chromium, Iron,

Nickel, and Copper :————

Potassium, Strontium, Cadmium,

And Gold are doubtful.

NAME OF A METALLOID EXISTING IN A  
COMET.

METALLOID : Carbon.

ELEMENTS EXISTING IN DRACO NEBULÆ.

METALLOIDS : Nitrogen and Hydrogen.

METAL : Barium (doubtful)

METALLOIDS EXISTING IN CERTAIN OTHER  
NEBULÆ.

METALLOIDS : Hydrogen and Nitrogen.



ELEMENTS OBTAINED FROM VARIOUS  
METEORITES.

METALLOIDS : Carbon, Oxygen, Silicon.

Phosphorus, Sulphur, Titanium, and Tin.

METALS : Lithium, Sodium.

Potassium, Calcium, Strontium.

Aluminium, Magnesium.

Chromium, Manganese, Iron, Nickel.

Cobalt, Lead, and Copper.





## APPENDIX.

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### ALPHABETICAL COMPOSITION NAMES.

---

IN reading the names of chemical compounds, many persons are disappointed at their length and unmeaningness to them. In verbal knowledge the memory space in the human mind may be compared to a room,—for example, a Store Room in a National Laboratory, the inner walls being cased with drawers made of transparent material, the greater number of them being distinctly labelled. The size of the Store varies with different men, but these words of many syllables must take up the same space in each, and there is a fear of filling up the store of small capacity. The limitation may arise from youth, or, undevelopment from want of class training.

With a polysyllabic name, there is first,—the trouble of com-

mitting it to memory, as it were to store it, then, to express it,—there is loss of time in finding it, loss of extra labour in dragging out the word, and, finally, physical difficulty in vocalizing it.

To bring minds of the briefest capacity, to the greatest use, we should have simple language ; simple words, which—on reflection—contain the largest amount of dilatable thought. It was with that idea, that felt want with many persons, I considered the formation of this (proposed) composition alphabet, to make chemical names more easily understood.

I divide my proposition into two parts. First, I propose the alphabetical composition names to substitute the present names of the Chemical Elements, for reason that their distinctive syllable, used as symbols in a chemical equation, will show their position in the grouping of the Elements (denoting whether they are of the first or second group), and in the case of a metalloid, will suggest its combining weight and chemical energy ; in the metals, its klan and chemical energy.

Second, I propose when naming a chemical compound that these names, abbreviated to the one syllable, be so arranged, that they shall represent the true, Elementary

arrangement of the substance as nearly as we know; so that, in working out a chemical equation, the actual self-explanatory name of the compound would be form'd, and all such anomalies as four or five different poly-syllabic names for one compound be for ever avoided. Upon—perhaps—the following rules:—

Supposing the element of greatest combining weight, to be the nucleus of a compound; then, let its syllable, be the terminal syllable for the name of the compound, the other elements of the compound being arranged in order of their combining weight, the lightest to go first, as in Hydrogen Hypochlorite, which would thus be call'd AbBeEb. In the case of a metalloid and metal, where the combining weight of metalloid is greater than the combining weight of metal, it could be arranged alphabetically—as metalloided metal. Where the combining weights of two in the same **Group** are equal, the alphabetical order to be adopted.

In composing the 63 different di-lettered sounds, to individualize each Element, care was taken to avoid any similar sounding terms to **gen**, **ine**, and **yan**, the affixes used to describe the condition of the Elements at common temperature,

gen being the termination for Gases.

ine „ „ „ „ Liquids,

yan „ „ „ „ Solids,

also avoiding the sounds of the combining numerical prefixes, Mon, Di, Tri, Tetra, Pent, &c. The whole being arranged as nearly as possible in accordance with the English alphabet. Such letters as would have given like sounds have been rejected.

**One** letter of the common alphabet (in most cases) is used to commence the names of **three** Elements.

**Rule.**—The vowels a, e, i, o, u, have the letters **b, m, t**, placed consecutively to each trio, as Ab (abb), Am (amm), At: the consonants, (excluding c, p, q, and x) have the letters **a, e, t**, placed consecutively to each trio, as ba (bay), be (bee), bt (bit). Two consonants—as Dt—are pronounced as if the letter i intervened, as Dit.

By a little practice, and repeating the names aloud, an exact idea is formed, of the chemical composition of any mineral compound.

# APPENDIX

## ALPHABETICAL COMPOSITION NAMES

FOR

### THE CHEMICAL ELEMENTS

AND

### THEIR MINERAL (FLORAL) COMPOUNDS.

#### FIRST GROUP OF ELEMENTS.

#### METALLOIDS.

Alphabetical Name.	Composition Name in brief.	Pronounced.	Present Name.	Instance of Compound Name now in use.	The Composition Name.
ABGEN	Ab	Abb	Hydrogen	Water (Hydrogen Monoxide)	DiAbBe
AMVAN	Am	Amm	Boron	Hydrogen Dioxide Boracic Acid	DiAbdiBe
ATYAN	At	Att	Carbon	Boron Trichloride Carbon Monoxide	TriAbAmtriBe AmtriEb
BAGEN	Ba	Bay	Nitrogen	Carbon Dioxide Nitrogen Monoxide Nitrogen Trioxide	AtBe AtdiBe DiBaBe DiBatriBe



## METALLOIDS CONTINUED.

Alphabetical Name.	Composition Name in brief.	Pronounced.	Present Name.	Instance of Compound Name now in use.	The Composition Name.
BEGEN	Be	Bee	Oxygen	Chlorine Monoxide	BediEb
BTGEN	Bt	Bit	Fluorine	Sodium Dioxide	DiBediIm
DAYAN	Da	Day	Silicon	Hydrogen Fluoride	AbBt
DEYAN	De	Dee	Phosphorus	Calcium Fluoride	DiBtJt
DTYAN	Dt	Dit	Sulphur	Silicon Dioxide	DiBeDa
EBGEN	Eb	Ebb	Chlorine	Silicuretted Hydrogen	TetrAbDa
EMYAN	Em	Emm	Titanium	Phosphorus Trioxide	TriBediDe
ETYAN	Et	Ett	Vanadium	Phosphorus Pentoxide	PentBediDe
FAYAN	Fa	Fay	Arsenic	Sulphurous Acid	DiBcDt
FEYAN	Fe	Fee	Selenium	Sulphuric Anhydride	TriBeDt
FTINE	Ft	Fit	Bromine	Hydrogen Hypochlorite	AbBeEb
GAYAN	Ga	Gay (α hard)	Tin	Chlorine Tetroxide	TetraBediEb
				Titanic Fluoride	TetraBtEm
				Titanic Acid	DiBeEm
				Vanadium Pentoxide	PentBediEt
				Vanadium Oxeychloride	BetriEbEt
				Arsenuretted Hydrogen	TriAbFa
				Arsenic Disulphide	DiDtdiFa
				Hydrogen Selenide	DiAbFe
				Selenium Dioxide	DiBeFe
				Hydrobromic Acid	AbFt
				Bromine Monoxide	BediFt
				Stannous Chloride	TriEbGa
				Stannous Sulphide	DtGa

Alphabetical Name.	Composition Name in brief.	Pronounced.	Present Name.	Instance of Compound Name now in use.	The Composition Name.
GEYAN	Ge	Ge (g hard)	Antimony	Antimony Pentoxide	PentBediGe
GTYAN	Gt	Git (g hard)	Iodine	Antimony Trichloride	TriEbGe
HAYAN	Ha	Hay	Tellurium	Iodine Pentoxide	AbGt
HEYAN	He	Hee	Bismuth	Telluretted Hydrogen	PentBediGt
				Tellurium Dioxide	DiAbHa
				Bismuth Trichloride	DiBeHa
				Bismuth Trioxide	TriEbHa
					TriBediHe

## SECOND GROUP OF ELEMENTS. METALS.

### 1ST KLAN.

IBYAN	Ib	Ibb	Lithium	Lithium Hydrate	AbBeIb
IMYAN	Im	Imm	Sodium	Sodium Chloride	EbIm
ITYAN	It	Itt	Potassium	Potassium Nitrate	BatriBeIt
JAYAN	Ja	Jay	Rubidium	Oxide of Rubidium	DiBeJa
JEYAN	Je	Jee	Cæsium	Oxide of Cæsium	DiBeJe

### 2ND KLAN.

JTYAN	Jt	Jit	Calcium	Calcium Chloride	DiEbJt
KAYAN	Ka	Kay	Strontium	Strontium Monoxide	BeKa
KEYAN	Ke	Kee	Barium	Barium Chloride	DiEbKe

## METALS CONTINUED.

Alphabetical Name.	Composition Name in brief.	Pronounced.	Present Name.	Instance of Compound Name now in use.	The Composition Name.
3RD KLAN.					
KTYAN	Kt	Kit	Aluminium	Alumina	TriBediKt
LAYAN	La	Lay	Yttrium	Yttria	BeLa
LEYAN	Le	Lee	Cerium	Cerium Protoxide	BeLe
LTYAN	Lt	Lit	Lanthanum	Lanthanum Chloride	ElLt
MAYAN	Ma	May	Didymium	Didymium Sulphide	DtdiMa
MEYAN	Me	Mee	Erbium	Oxide of Erbium	BeMe
4TH KLAN.					
MTYAN	Mt	Mit	Beryllium	Beryllia	TriBediMt
NAYAN	Na	Nay	Magnesium	Magnesium Chloride	DiEbNa
NEYAN	Ne	Nee	Zinc	Zinc Carbonate	TriBeAtNe
NTYAN	Nt	*Nit	Indium	Oxide of Indium	BeNt
OBYAN	Ob	Obb	Cadmium	Cadmium Monoxide	BeOb
5TH KLAN.					
OMYAN	Om	Omm	Chromium	Chromium Trioxide	TriBeOm
OTYAN	Ot	Ott	Manganese	Manganese Dioxide	DiBeOt
RAYAN	Ra	Ray	Iron	Ferrous Sulphide	DtRa
REYAN	Rc	Ree	Cobalt	Cobalt Chloride	DiEbRe
RTYAN	Rt	Rit	Nickel	Nickel Monoxide	BeRt
SAYAN	Sa	Say	Uranium	Uranous Oxide	BeSa

## METALS CONTINUED.

Alphabetical Name.	Composition Name in brief.	Pronounced.	Present Name.	Instance of Compound Name now in use.	The Composition Name.
6TH KLAN.					
SEYAN	Se	See	Zirconium	Zirconia	DiBeSe
STYAN	St	Sit	Niobium	Niobic Acid	PentBeSt
TAYAN	Ta	Tay	Tantalum	Tantalic Acid	PentBeTa
TEYAN	Te	Tee	Thorium	Thoria	BeTe
7TH KLAN.					
TTYAN	Tt	Tit	Molybdenum	Molybdic Acid	TriBeTt
UBYAN	Ub	Ubb	Tungsten	Tungstic Acid	TriBeUb
8TH KLAN.					
UMYAN	Um	Umm	Thallium	Thallium Hydroxide	AbBeUm
UTYAN	Ut	Utt	Lead	Lead Sulphide	DtUt
9TH KLAN.					
VAYAN	Va	Vay	Copper	Copper Chloride	DiEbVa
VEYAN	Ve	Vee	Silver	Silver Nitrate	BatriBeVe
VTINE	Vt	Vit	Mercury	Mercurous Chloride	DiEbdiVt
10TH KLAN.					
WAYAN	Wa	Way	Rhodium	Rhodium Sesquioxide	TriBeDiWa
WEYAN	We	Wee	Ruthenium	Ruthenious Chloride	TriEbWe

## METALS CONTINUED.

Alphabetical Name.	Composition Name in brief.	Pronounced.	Present Name.	Instance of Compound Name now in use.	The Composition Name.
WtYAN	Wt	Wit	Palladium	Protoxide of Palladium	BeWt
YAYAN	Ya	Yea	Gold	Gold Monochloride	EbYa
YEYAN	Ye	Yee	Platinum	Platinum Dioxide	DiBeYe
YTYAN	Yt	Yit	Iridium	Iridic Chloride	TetrEbYt
ZKYAN	Zk	Zik	Osmium	Osmic Acid	TetraBeZk

## ERRATA .



Page 6, line 9.—Strike out this line.

Page 35, line 7.—For “solvent” read “dissolved.”

Page 55, line 14.—For “Nitric Oxide” read “usually termed.”

Page 57, line 15.—For “Ammonium Oxide” read “Ammonium Hydrate.”

Page 61, line 15.—For “Body Affection,” read “Bodies-Affection'd.”

Page 65, line 7.—Strike out this line.

Page 104, line 19.—Strike out “Iodides,” transpose “and.”





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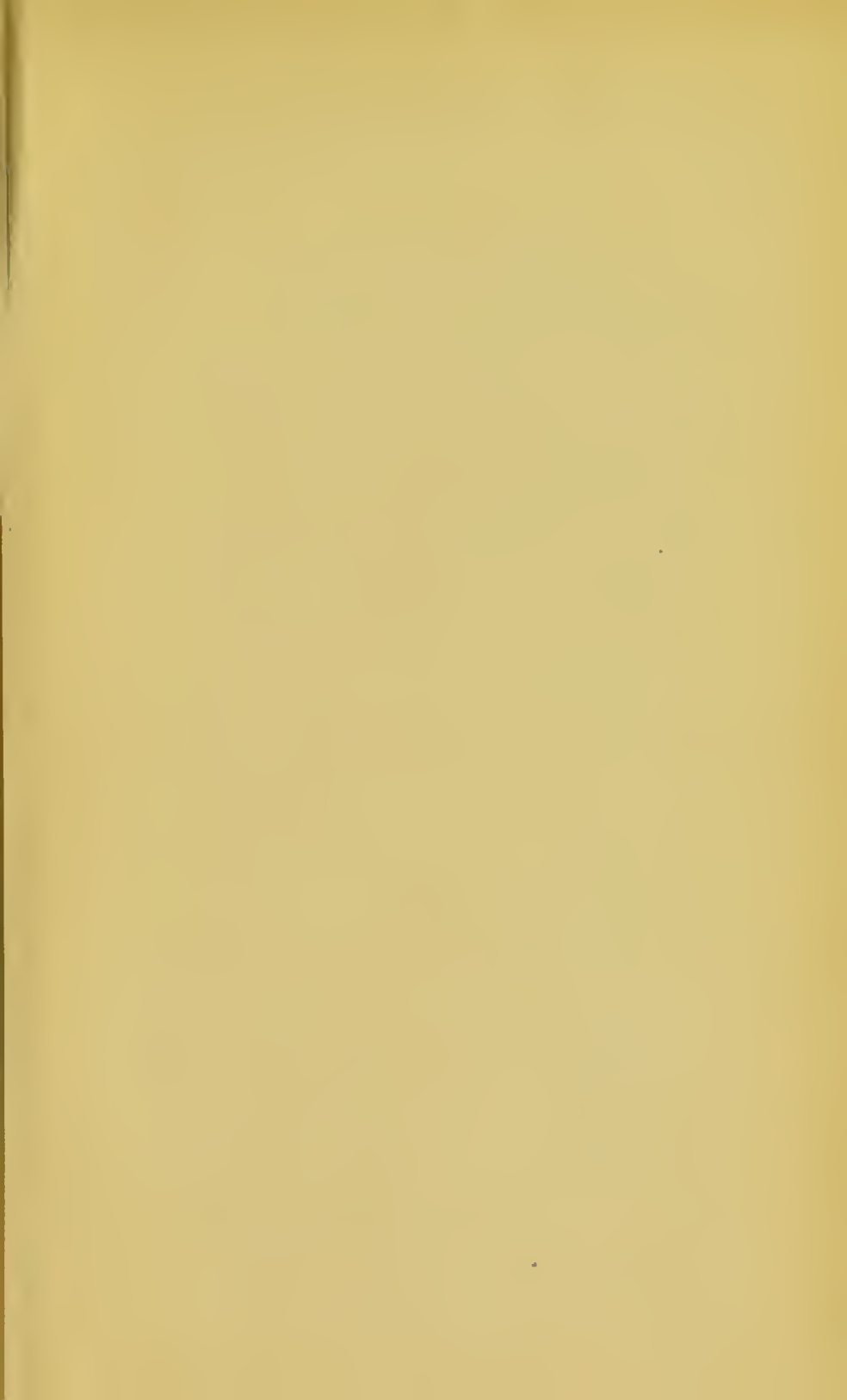
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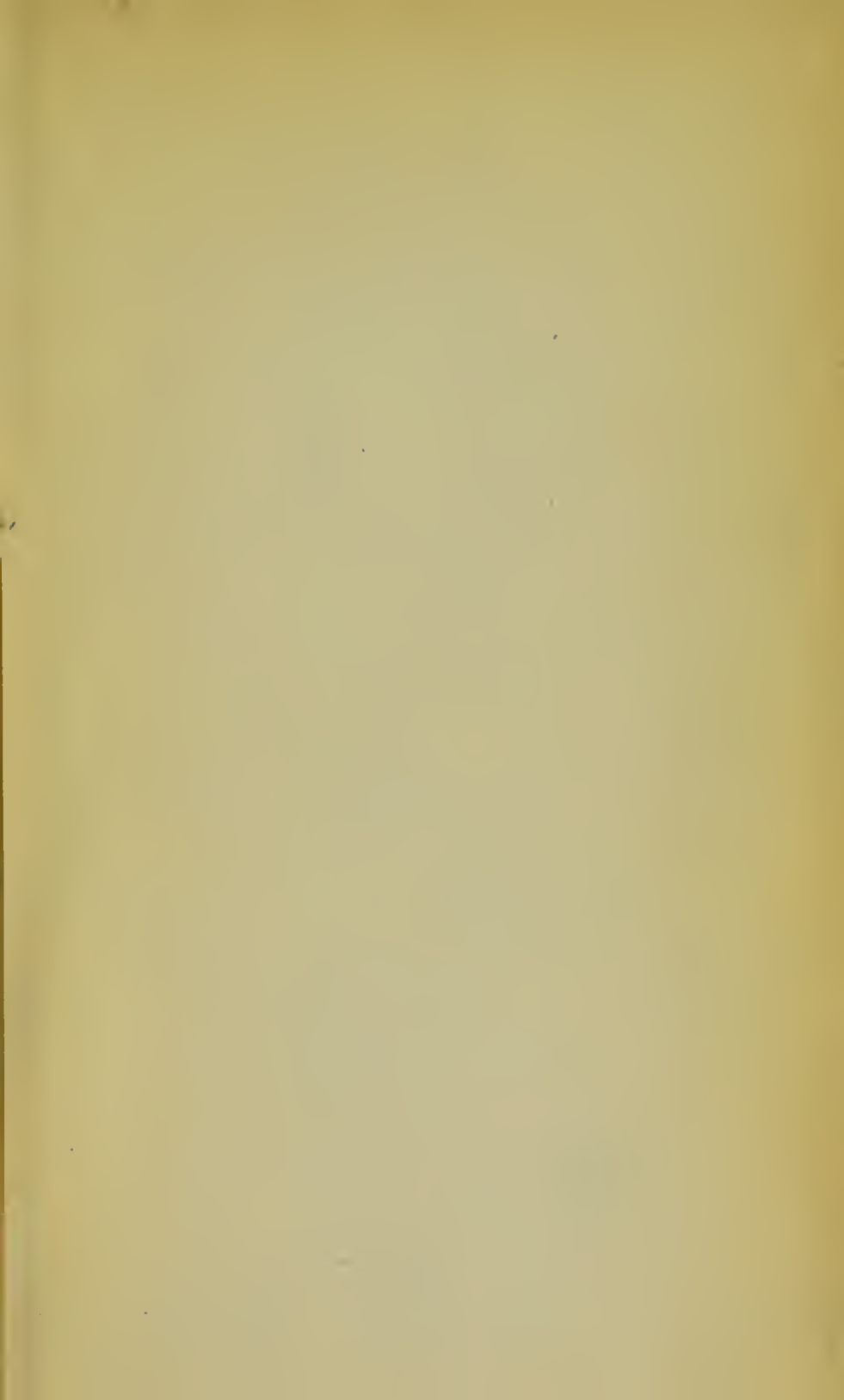
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